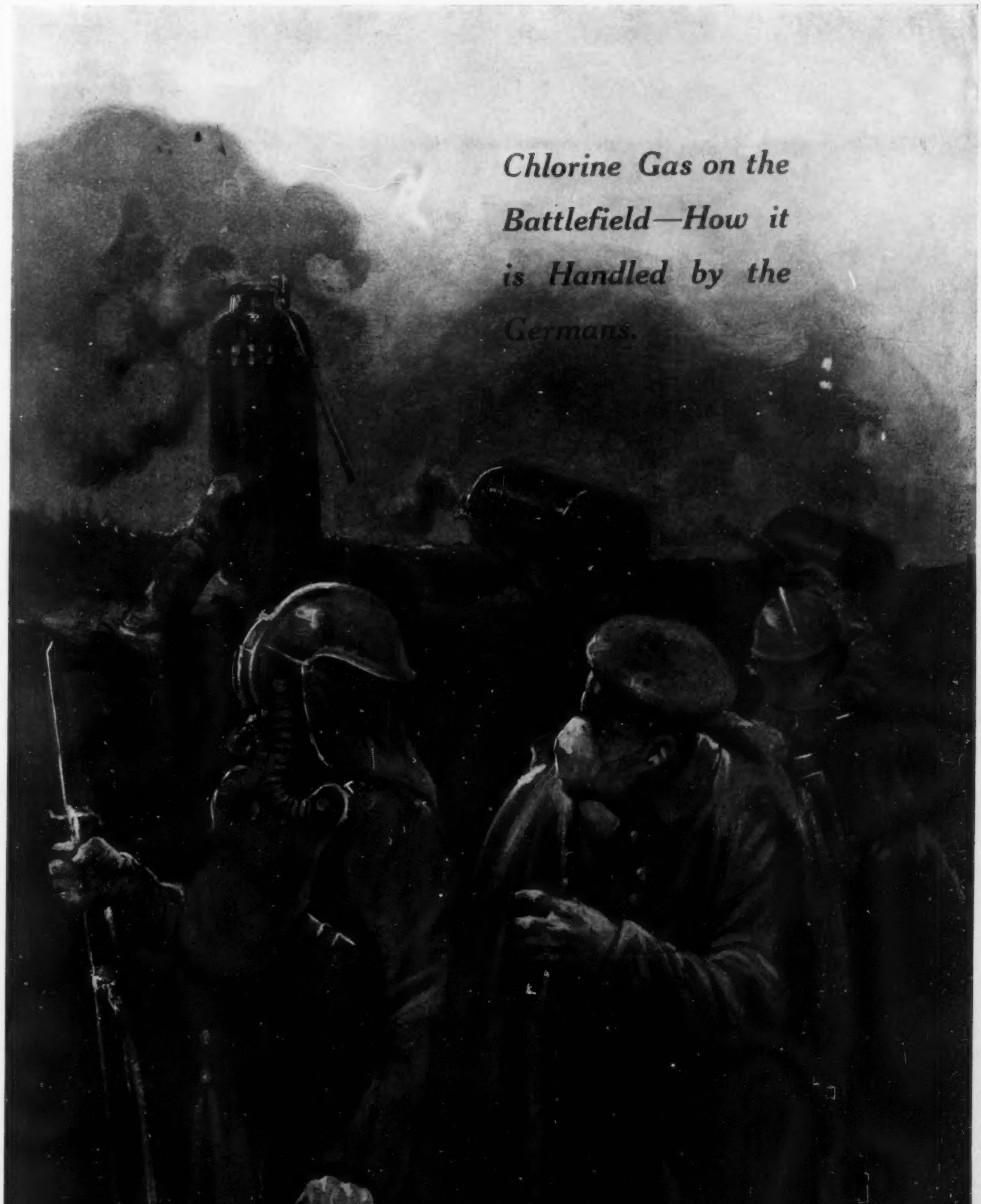
SCIENTIFIC AMERICAN



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The

70th Anniversary

NUMBER of the

SCIENTIFIC AMERICAN

June 5th, 1915

THE Scientific American was founded seventy years ago, at a time when the United States of America was industrially less developed than South Africa at the present time. Even territorially, it was not the same country we know now; for California, Texas, and the great Southwest belonged to Mexico.

During that long period of seventy years the Scientific American faithfully chronicled the technical and industrial progress which we Americans made. Its editors saw the advent of the reaper, the telegraph, the telephone, the great trans-continental railways, the laying of the trans-atlantic cable, the development of the giant steamship, the perfection of the phonograph, the glow of the first electric incandescent lamp, the coming of the motion picture machine, the miracles wrought by wireless telegraphy, and more recently the conquest of the air.


THE SCIENTIFIC AMERICAN OFFICE 1859

What an age of wonders it has been! What a transformation has been wrought upon the face of the earth! Surely no tale of the Arabian Nights, no fantasy of Jules Verne depicts marvels so amazing as those which the Scientific American has been the first to describe authoritatively as soon as they appeared. Who would have thought, seventy years ago, that with the aid of the X-rays we could look through a man's body; that friend could talk with friend from New York to San Francisco; that Niagara Falls would illuminate cities; that street cars would move magically through our towns without any apparent means of propulsion; that pictures would be sent by wire from New York to Chicago, and that by means of the boundless ether a solitary passenger ship on a desolate ocean still keeps in touch with civilization.

It has been the privilege of the Editors of the Scientific American to know the men whose master minds have wrought these things, and to hear from their own lips the story of their struggles and their triumphs. Ericsson, Morse, Edison—the whole dynasty of inventive genius which has made the nation what it is—the editors have known them all.


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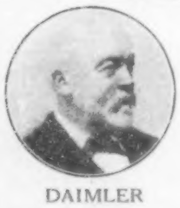
THE SCIENTIFIC AMERICAN OFFICE 1915

Seventy years is a turning point not only in the life of man, but in the life of any enterprise. It seems fitting that the occasion should be commemorated by the publication of a number which will review the progress that the United States of America has made in the three-score years and ten of our existence.

In June a number will appear which the Editors hope will do full justice to the great theme of American invention—a number which will transport us all back to the time when our fathers and our grandfathers still burned candles, when horses pulled street cars, when there were no automobiles and when the steam railway was a curiosity that people would travel miles to see. The motion picture machine of industrial progress will be turned backward, and the flickering film will make you wonder what the future will have in store if so much that is wonderful has happened in the past.

MUNN & COMPANY, Inc., Woolworth Building, New York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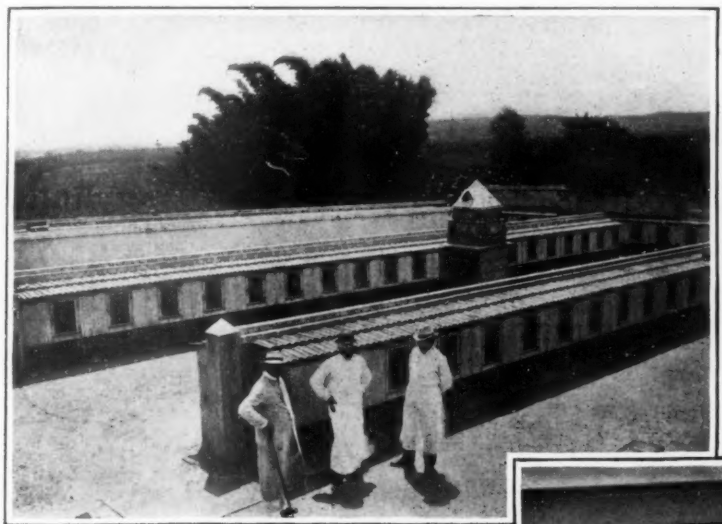

Pens for small animals.

The garden of serpents.

Capturing a venomous snake with a forked stick.

A Garden of Serpents

IN the Serotherapic Institute of Brazil, which occupies a tract of 700 acres at Butentan, Dr. Vital Brazil produces serums for the cure and prevention of the effects of snake bites. The snakes used in preparing the serums are kept in a small park, containing numerous dome-shaped shelters, which is surrounded by a wall and a ditch filled with water. Other specimens are kept in a similar park, near the main building, in order to study their habits, favorite food, the very diverse venomous properties of various species, and the best method of escaping their attacks. The hot and moist forests of Brazil swarm with venomous serpents, but the slightest noise alarms the peaceful and timid reptiles, which attack only those persons and animals that tread on them or destroy their lairs. The principal families are the Bothrops and the Crotales, or rattlesnakes. The Bothrops venom decomposes the blood and produces internal hemorrhage, with intense congestion of the liver, kidneys, and brain, while the venom of the Crotales paralyzes the respiration, circulation and vision, and usually causes death within 24 hours. Each venom requires its special antidote. Dr. Brazil prepares a serum for each, and also a polyvalent or compound serum, which is effective against all Brazilian snake venoms, for use when the species of the attacking snake is unknown.

The serums are obtained from young and sound horses and asses, which receive, at intervals of 5 or 6 days, injections of venom, increasing from one twentieth milligramme to one gramme. A year's treatment is required to produce perfect immunity and an effective serum. The polyvalent serum is obtained by injecting the venoms of Bothrops and Crotales alternately. The animals thus immunized furnish anti-venom serum for a long time, if they receive a fresh injection of venom after each extraction of serum. Tubes of serum, with hypodermic syringes, are sent gratuitously to hospitals, municipalities and poor patients. Others are sold at low prices or exchanged for live snakes. In 1913 about 900 tubes of rattlesnake serum, 800 of Bothrops serum, and 4,500 of polyvalent serum were distributed, and 4,500 snakes were received. Serums for pest, diphtheria, and tetanus also are produced by the usual methods.

In the course of his study of Brazilian serpents, Dr. Vital Brazil has discovered a non-venomous constrictor snake, the *mussurana*, which is naturally immune to snake venom, and which kills venomous snakes by crushing them in its coils, and then devours them.

It is a remarkable fact that the serums prepared at Lille by Dr. Calmette, the originator of the serum treatment for snake bites, are powerless against the venom of Brazilian serpents.—*Abstract of an article by Jacques Boyer.*

A Bird Mystery.—One of the most curious and interesting of the unsolved problems relating to bird migration, according to Mr. W. W. Cooke's recent memoir on this subject, is connected with the chimney swift, more often called the chimney "swallow," a very common and well-known bird of the eastern United States. After the breeding season the flocks drift slowly south and concentrate in vast numbers on the northern coast of the Gulf of Mexico. Then they disappear as completely as if they hibernated under the water or in the mud, according to the old belief regarding birds in general. The last week in March they appear again on the Gulf coast. "Their hiding place during the intervening five months," says Mr. Cooke, "is still the swift's secret." (Chapman's "Handbook" says that they winter in Central America.)

Some inmates of the Garden of Serpents.

High-speed Stars

IN order to obtain more exact figures in connection with the sun's motion through space and other similar problems, astronomers are measuring the velocity and direction of a great number of stars, which, like the telegraph poles along a railroad track, seem to go rapidly backward as we move forward.

The fact that these stars have motions of their own complicates the case considerably, for the "fixed stars" are known to be moving in great streams and change their positions not only in relation to our solar system, but also in relation to each other.

The motion of a star naturally resolves itself into two parts: one measured along the line of sight representing its amount of approach toward us or its retreat, the other measured at right angles to a line drawn from the star to the observer.

The first of these motions is measured by a study of changes in the star's spectrum, the second by comparing its position as measured accurately at dates many years apart.

The velocity of a star seems to be a factor of its effective age. Unlike our ordinary human experience, the speed of a star increases with its advancing years, and in the whirl of spheres above us it is the young who cannot keep the pace.

The average velocity of stars ranges from about 6 kilometers, or between three and four miles, per second for "young" stars to about 30 kilometers per second for "old" ones. But notable exceptions occur. At Mount Wilson Solar Observatory of the Carnegie Institution some stars have been found to move with velocities of 141, 150, 179, 233, 316 and even 325 kilometers per second, the highest speed yet known.

These high velocity stars are sometimes described as runaways, because they seem to be quite beyond the control of the gravitational power of the universe. At their speed the attraction of the entire known stellar system would be wholly insufficient to check the star's career through space.

The astronomer, Simon Newcomb, once calculated that the maximum velocity attainable by a body starting with velocity zero at an infinite distance and passing through a stellar system containing one hundred million stars each five times as massive as our sun and distributed throughout a disk-like spheroid of certain extent cannot exceed 40 kilometers per second. Yet the star "Groombridge 1830" has a speed nearly nine times this value, and the massive star Arcturus has a speed probably four times this value.

If existing velocities owe their magnitudes to the gravitation of the system, the quantity of attracting matter in the whole stellar system would have to be at least eighty times that assumed by the calculations of Prof. Newcomb.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The President and Our People

As our readers very well know, during the heartrending struggle which has been taking place in Europe during these many months, the Scientific American has maintained an attitude of neutrality. It has endeavored to follow out strictly the injunction of the President at the outbreak of the war. It has witnessed with concern and with feelings of horror the many acts which have been committed in the name of war. It has felt that it was the part of every American citizen, however, to refrain from showing any active partisanship in this crisis. During the last few weeks, however, the nature of the war has changed, and not only the feeling but the demand for a strict moral neutrality has been disturbed by certain acts of the Teutonic allies, which cannot be excused or palliated. We refer, of course, to the attacks which have been made upon shipping of neutral nations. Ships of the United States, Holland, Sweden, and Norway have been sunk without warning, and the flag of these countries has been no protection against these acts of depredation. The people of this country have viewed with the gravest anxiety the apparent systematic policy of the German government to carry out its imperial will irrespective of the rights of nations or of individuals. The horror following the sinking without warning of the "Lusitania" only emphasizes the shocking character of the situation. Has this ceased to be a war of army against army and degenerated into a war against civilians and women and children, no matter of what nationality?

This is the first instance in the history of mankind where a regular transatlantic liner, filled with civilians of many nationalities, has been deliberately sunk on the high seas, and this act was committed, not after allowing innocent women and children to escape in lifeboats, but wantonly and wickedly without allowing the victims of the weapon of destruction any chance for their lives. It cannot be claimed that this act was the irresponsible whim of the commander of the submarine, for an advertisement appeared in the American press prior to the sailing of the "Lusitania" warning passengers against sailing on the high seas. It would seem evident from this warning that this horror is the result of the deliberate policy of the imperial will.

During the first months of the war the imperial government sent its apologists to this country to try and explain away the crime against Belgium and the wanton destruction of some of the choicest works of art of Europe; but their arguments and pleas failed to convince, because our people felt that such matters could not be solved by the thumb rule of a lawyer's brief. Our people do not accept as a mandate the claim that "war is war." They have the highest respect for and belief in the justice of international law, but such a code has limitations which do not harmonize with the ideals of the American people, who realize that there is a higher law—the law of humanity and civilization—which is being outraged and trampled upon. And it is for that reason, and in spite of the calm and generally neutral attitude of the American press, that underneath there has been a strong current of opinion among the American people, which absolutely condemns the methods of war now being conducted by the Teutonic allies.

The Scientific American wishes to enter its protest against these acts. It fears for the future of civilization if such acts are accepted under any plea which does violence to the accepted codes of warfare.

In this country there are some 10,000,000 of American citizens of German birth or German descent. They may be considered among our most enlightened, intelligent, and staunchest citizens. At the time of our civil war they rendered inestimable service to the cause of the Union. They form an integral part of our body politic. He would be a poor thing, indeed, who would begrudge any native-born German the love of the country of his birth, but to such, as well as to native-born Americans, who have become imbued with the American spirit, we would appeal in the name of civilization and humanity that some effort be made to bring home to the friends on the other side a realization that the methods of war now being followed are entirely out of keeping with the ideals of liberty and the rights of humanity which this United States of America holds as its cherished possession. A grave responsibility rests upon the President of the United States at this crisis. It is a fortunate thing for the people of this United States that they have at the head of the Government one in whom they have every confidence, who all through this long and painful struggle has shown a wisdom, a patience, a conscientiousness, and a high-mindedness which have evoked the admiration of all American citizens. The rights of our citizens are being abused, the rights of humanity are being violated, and what course is it possible for us to assume? This we leave in your hands, Mr. President. It is against the tradition and the unwritten law of this land for us to engage in any European conflict; the policy of our Government for the last one hundred and twenty-five years has been so shaped that we are not prepared to engage in such a conflict; it is not our purpose or our wish. The establishment of a large standing army is contrary to the spirit of our people. We have neither the army nor equipment necessary for war, even did our wishes incline us in such a direction, so that such a policy is hardly to be entertained. Our fleet would be of little, if any, service in this invisible marine warfare. We are content to leave in your hands, Mr. President, the shaping of the course which this great nation should pursue, feeling that the rights of its citizens will be fully protected, and that its reputation for honor, for fair dealing and dignity will not be allowed to suffer.

To the Hon. Josephus Daniels, Secretary of the Navy:

We have received from you a copy of a letter written by you to President Garfield of Williams College on the subject of the preparedness of the Navy, and in your letter of transmission you state that it occurs to you that we would be interested in this letter.

The letter does interest us exceedingly, partly as a statement of the excellent work which has been done for the Navy under your administration, but far more as a revelation of the spirit in which you are conducting the duties of the high office to which you were called, and which you now fill.

We have read your letter through more than once, and very carefully, and we have to confess that the strong impression left upon our minds is that you are more concerned to prove that the work done under your administration in building up and improving the Navy has been superior to that done under the previous administration than you are to show whether our Navy is in the condition of strength and preparedness relatively to the other navies of the world which the present very serious international situation demands.

To bring home to your mind why we consider that your point of view is rather the narrow political than the broadly patriotic one, we quote from your letter. You say: "What has been done since Wilson's inauguration to make the Navy stronger, in ships, in ammunition, in mines, in torpedoes? These questions are of the utmost importance. Let me answer them briefly: First as to the ships: During the last two years of the Taft Administration, Congress authorized the construction of two dreadnoughts to cost about $13,000,000 each. During the first two years of the Wilson Administration, upon my recommendation, Congress authorized the construction of five dreadnoughts to cost about $14,000,000 each." (We cannot forbear to remind you, just here, that one of those dreadnoughts was secured at the cost of two existing battleships of our Navy, the "Idaho" and the "Mississippi," which were sold to Greece.) "Stated in dollars, the Wilson Administration in its first two years authorized $70,000,000 to be spent on the chief fighting force of the Navy as against $26,000,000 authorized during the last two years of Taft's"; and so forth and so on.

Again, speaking of submarines, you say: "The Sixty-third Congress elected with Wilson adopted my recommendation to give us all the money it could for submarines. . . . These submarines will cost $16,260,000. Now, what was done during the last two years under Taft? Twelve submarines to cost $7,958,936 were authorized."

And again, under the heading of "The Savings Effected," you say: "During the four years of Taft, $21,928,572 was appropriated by Congress for the public work alone of shore stations. Two naval bills have been passed by the present Administration, and they carry together, for the public work of shore stations, a total of $3,920,880."

Finally, in the last paragraph of your letter to President Garfield, you make a statement which in one broad and bold proposition seems to indicate that you look at this subject as a political rather than a national problem. You say that one of the reasons for the length of your letter is: "Because certain persons, ignorant of their ignorance, and for selfish partisan reasons, have busied themselves with misrepresenting the true conditions of the Navy, thereby causing some good people to fear that the Navy is not now as in the past, the strong, effective, right arm of the republic."

Is it to be inferred from such a statement that you are of the belief that no one can criticise the naval policy of your administration except from political motives.

The interest of the Scientific American, and of every journal, technical or otherwise, in the United States Navy, and the interest of 90 per cent of the citizens of this great country in the Navy, is a patriotic one, and it has nothing whatever to do with politics.

The American public cares not one jot or tittle whether the Wilson Administration or the Taft Administration or any other Administration has done more or less than preceding or following Administrations have done, but it does care very much, indeed, whether the party in power is taking a broad and statesmanlike view of the situation; whether it is endeavoring to build our Navy up to a condition of strength and keep it in a state of preparedness, which will enable it to safeguard the vital interests of this country.

For many years the Scientific American has claimed that the root trouble with the Navy is that the question of appropriations has been made a political one; that Congress, instead of regarding the matter of naval and military preparation as a vital one to be placed far above all party politics, has preferred, year after year, to throw the recommendations of its naval experts into the political bag, to take their chances with the Pension Bill, the River and Harbor Bill, and the whole of those purely local and individual questions which make up the contents of what, not very euphoniously but very aptly, has been termed the "Pork Barrel." Whether Congress may realize the fact or not, there is no doubt whatever that the nation at large has awakened to the fact that our naval and military forces are totally inadequate for the onerous duties which are liable at any time to be laid upon them. The American people have learned the lesson of this terrible European war. They realize that the question of adequate armament is one affecting the very life and death of the nation. We believe that the whole country is in a frame of mind to treat this question as such, and we are perfectly certain that the very last thing that they care about, or wish to hear about, is whether the Wilson Administration or the Taft Administration spent the larger or the smaller number of dollars and added the larger or the smaller number of ships to our naval resources in a given length of time.

Somebody has defined genius as the possession of a strong sense of proportion, and we cannot help but feel that in this hour of stress and danger there is a strong call for genius of this stamp.

Cannonading and the Weather

The wet winter in Europe has brought forth the inevitable suggestion from many quarters that the cannonading incidental to the war had something to do with it. The excessive rainfall, as compared with the normal, appears, however, to have been greater in the British Isles than on the Continent; in other words, not only at a considerable distance from the main theater of war, but also to windward of it. British rainfall during November to February was about 50 per cent above the normal. As to the Continent, Camille Flammarion points out that October, 1914, was a dry and sunny month, in spite of the tremendous battles then in progress; that the rainy periods during the winter coincided—exactly as in the piping times of peace—with the advent of cyclonic disturbances from the Atlantic Ocean; and that the recent rains are by no means without precedent in normal times. The veteran astronomer cautiously adds, however, that we must not be hasty in drawing conclusions either *pro* or *con*.

Concrete Gasometer Work.—Reinforced concrete is now coming into successful use in the construction of gasometer basins. A recent example of the Hennebique concrete system is noted in a circular basin of this kind which was recently built at St. Sebastian, Spain, and it is the first example to be found in that country. Diameter is about 80 feet, and height of basin 26 feet. Around the basin are enlargements in the shape of 9 buttresses in order to add to the strength of the construction, and each buttress serves as the base for one of the structural iron beams which go to make up the gasometer framework and support the gas-holder.

Notes on the War

German Foresight.—Speaking of German foresight, Hilaire Belloc says that in his power to maintain close formation; in the use of high-explosive shells on permanent fortifications, and in the use of heavy pieces in the field, the German has proved that his theories of modern war were correct. The advantage in material is slowly passing to the Allies.

Long-range Bombardment.—The astonishment which was aroused by the fact that the Germans were able to bombard Dunkirk from a distance of over 20 miles was confined entirely to the lay public; for military men, and particularly artillerists, have long known that it was possible to throw shells to a distance of 20 and even 30 miles if it was considered desirable to do so. It is probable that neither the German 16½-inch, nor the Austrian 12-inch gun was used, for neither of these pieces can cover any such range. More than likely a 12-inch naval piece of the older, short-caliber pattern was used and fired at a high angle of elevation.

The New Attempt at the Dardanelles.—The new attempt to break a way through the Dardanelles by a combined sea-and-land attack is more in accordance with the established tactics of such warfare than was the first attempt to batter a way through from the sea. It is possible that the Turkish batteries along the Straits are no better provided with defenses against attack from the land side than are the defenses along the coast of the United States. In that case, if the Allies have sufficient forces available, the forts will be taken in reverse. If the line of forts on the European side be captured, the task of reducing those on the Asiatic side will be greatly simplified.

American Mechanical Transport.—The Allies are being supplied by American engineering firms with large quantities of mechanical transport. A considerable portion of this is of the type in which all four wheels are available for traction and braking. The advantages of this type for war conditions are obvious. Not only can these machines operate successfully on broken and yielding ground, but they can take inclines which would be impossible for mechanical transport of the ordinary type with rear-wheel drive and front-wheel steering. These machines have proved to be very serviceable on muddy and broken-down roads such as are encountered in Flanders and in Poland.

A War of Artillery.—The present struggle in Europe is a war of artillery; to the side which can produce a preponderance of artillery and an excess of ammunition supplies the victory will belong, other things being equal. Only those who are present on the battlefields of Europe can form any adequate idea of the enormous expenditure of ammunition, and particularly of ammunition for field guns and howitzers, which is taking place. In the House of Commons, the Chancellor of the Exchequer recently stated that during the battle of Neuve Chapelle as much ammunition was expended as was used during the entire Boer war, which latter lasted for two years and nine months. The Neuve Chapelle battle front covered only a few miles, whereas the whole fighting front in all the theaters of the present war must total fully 1,500 miles.

Radius of German Submarines.—According to an abstract in an article by a German officer, which appears in *Revista Marittima*, the number of German submarines at the opening of the war was 27, and adding those since completed the number would now be 36 if there had been no losses. New units have been laid down, also, and those building for foreign governments, were, of course, taken over. It is claimed that the water-ballast tanks are filled with oil when the boats start on a long cruise, and the article states that an 800-ton submarine such as "U-47", one of the latest to be put through her trials, cruising at 8 knots on the surface, would use 10 tons of oil fuel for every thousand miles. The boat is credited with a normal supply of 50 tons of oil which would give her a radius of 5,000 miles. If, as the writer suggests, the water-ballast tanks are utilized for oil storage, the radius of action would be even larger.

Six-inch Guns on Battleships.—The fact that all the naval engagements between the larger ships have been fought with heavy-caliber guns at the longest ranges at which these guns could be used with effect, has once more brought to the front the perennial question of the secondary batteries of warships. When Sir John Fisher brought out the first dreadnought and the first three battle-cruisers, he left out the secondary armament altogether; and several of the ships which followed them carried nothing heavier than 12-pounders and 4-inch guns in their secondary batteries. In the big engagements of the present war, including the fight off Chile, the 6-inch guns of the armored cruisers for the greater part of the time were out of range, and the 8.2, 12, and 13.5-inch guns settled the fight. Experience had in this war shows that flotillas of torpedo-boat destroyers are the best protection for battleships and battle cruisers against the enemy's destroyers. The substitution of 12-pounders for 100-pounder 6-inch guns would mean a considerable addition to the efficiency of the battleships either in speed, coal endurance, armor or other valuable qualities.

Science

The China Medical Board, recently established by the Rockefeller Foundation for the purpose of improving medical and hospital conditions in China, gives promise of doing incalculable good in a country where, aside from the medical missionaries, there have been heretofore very few representatives of modern medical science. The first task of the board will be to develop medical education in China, and to this end six fellowships have been established to enable Chinese students to take medical courses abroad, in order that they may ultimately teach medicine in their own country.

The Southern Ocean.—According to a note in the *Geographical Journal*, this name has been recommended by the British Admiralty and formally adopted by the Commonwealth of Australia and the Union of South Africa to designate the whole oceanic zone encircling the globe south of Australia, Africa, and South America. This name is, of course, not new, but it is not to be found in Lippincott's Gazetteer, and has been used in a merely tentative way by many geographers. As the Admiralty mentions the Antarctic continent as the southern boundary of this body of water, no room is left on the map for an "Antarctic Ocean."

The Siberian Sea Route.—Progress in the exploitation of the steamship route to Siberia by way of the Arctic Ocean has been reported from time to time in these columns. The American consul-general at Moscow states that interruption of other trade routes by the war will stimulate the use of the Arctic route, and that extensive preparations are now being made by the Siberian Association for Shipping, Trade and Industry for the shipping season of 1915. Hides, flax, hemp and other raw materials to a value of $500,000 will probably be sent by water to England. The association is building a settlement on the lower Yenisei.

Sheep-killing Dogs are said to be the chief cause of the marked decrease in the number of sheep kept on farms in the United States, exclusive of the western division. During the period between 1900 and 1910 the total number of sheep in this region decreased by more than 3,900,000 head in spite of favorable market conditions. The problem of the sheep-killing dog is fully discussed in Farmers' Bulletin 652, just issued by the U. S. Department of Agriculture. In this bulletin it is pointed out that the moral effect upon persons who have witnessed the depredations committed by dogs among sheep is a more serious factor in the situation than the actual damage done. No farmer contemplating the raising of sheep is likely to venture on the enterprise while the flocks of his neighbors are continually meeting reverses through the attacks of dogs. The annual loss from this cause in 36 states is estimated at 107,760 head. Sheep-killing dogs sometimes work singly, but more often in groups of two or three. They do not limit their attacks to the flocks in the immediate vicinity of their homes, but travel for miles in all directions, spreading destruction in the flocks with which they come in contact. Some dogs simply kill one or two sheep in a flock, while others continue the attack until all the sheep are either destroyed or crippled. In many cases sheep are simply chased until they die of exhaustion. Most of the farm states have dog laws, and nominally provide some compensation for the sheep destroyed, but these laws are generally more or less ineffective. Improved legislation and the more general use of dog-proof fencing are suggested as remedies.

The Dissemination of Chestnut-blight Fungus by Wind is fully discussed by Messrs. Heald, Gardner and Studhalter in a recent number of the *Journal of Agricultural Research*. This method of dissemination was first suggested by Murrill in 1906, though he probably had only the pycnospores in mind. It has not yet, however, been demonstrated that the pycnospores can be carried on in this way. The studies of Rankin revealed the fact that under moist conditions the ascospores are shot forcibly out into the air, where they can be caught up and carried to considerable distances by the wind. Subsequent investigations showed that vast numbers of the ascospores are thus thrown into the air during summer rains. In order to get more definite information regarding this means of infection, the writers above mentioned carried out observations in a badly diseased chestnut coppice near West Chester, Pa., during the months of August and September. To determine the presence of spores of the chestnut blight in the air at particular times and places a series of exposure plates was made, while the number of spores present was determined by the aspirator method, and other tests were carried out. The general result of these inquiries is stated as follows: "All of the experiments point to air and wind transport of the ascospores of the chestnut-blight fungus as one of the very important methods of dissemination and substantiate the conclusions of Rankin and Anderson. It can now be said with absolute certainty that following each warm rain of any amount ascospores are carried away from diseased trees in large numbers. During dry periods wind dissemination of ascospores does not occur at all or sinks to a very insignificant minimum."

Aeronautics

Novel Flying Machine.—Patent No. 1,133,451 to C. A. Worfel of Grand Rapids, Mich., is for a flying machine having propelling wings which swing and have a limited rotary movement, the parts being so correlated as to secure a turning of the wings on their shafts when at one end of their swing and to turn them reversely at the other end of the swing, the wings being so inclined during the swinging movement as to propel the machine and also to sustain it or cause it to rise.

Parrots and Aeroplanes.—In the course of the present European war it has been noticed that parrots work themselves into a state of intense excitement and screech loudly on the approach of an aeroplane, even before the latter is visible to human eyes. A number of these birds were placed on the Eiffel Tower and other suitable points of observation in order to test their utility as sentinels. Unfortunately, however, they are unable to distinguish between friendly and hostile aircraft.

A Gammeter Flying Machine Patent.—H. C. Gammeter of Bratenahl, Ohio, has secured patent No. 1,135,009 in which wings arranged at opposite sides of the machine are pivoted about midway between their ends on axes parallel to the line of travel and these wings have their front edges stiffened and their rear edges flexible so there is a propelling action for the full width of both wings on each stroke, the wings being oscillated simultaneously about their respective axes by connection with the driving mechanism of the machine.

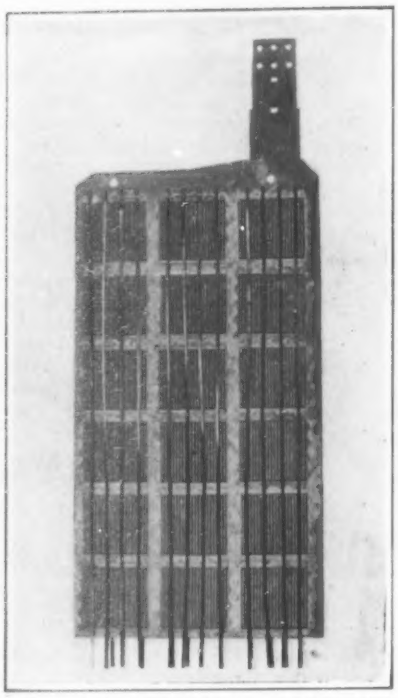
Life Saving Parachute.—A life saving parachute has been patented in which a device that may be worn as a garment has a flexible overhanging and relatively wide skirt band secured to the body portion at a point near its upper end and beneath the arms of the wearer and flexible stays are secured to the lower end of the body portion and to the outer edge of the overhanging band so that as the wearer descends his downwardly extending legs will operate upon the stays to hold the band at its outer edges so the latter will expand and operate as a parachute. The patent No. 1,133,924, has been issued to H. C. Brubacker of Sault Ste. Marie, Ontario, Canada.

Indications of Important Improvements.—Speaking of the importance of increasing the ranges of speed of aeroplanes a speaker at a recent meeting of the Royal Institution, London, brought out the fact that in 1912 the Cody machine, which won the military prize for that year, had a maximum speed of 72 miles and a minimum of 48 miles—a range of speed of 33 per cent. In 1914 a Sopwith machine had a maximum speed of 92 miles, while its minimum was 37 miles, the range being 60 per cent. In this connection it was noted that altering the shape of the wires on the aeroplane—from round to oval—had brought about a reduction from 10 to 12 per cent in the horse-power required for flying at 70 miles an hour.

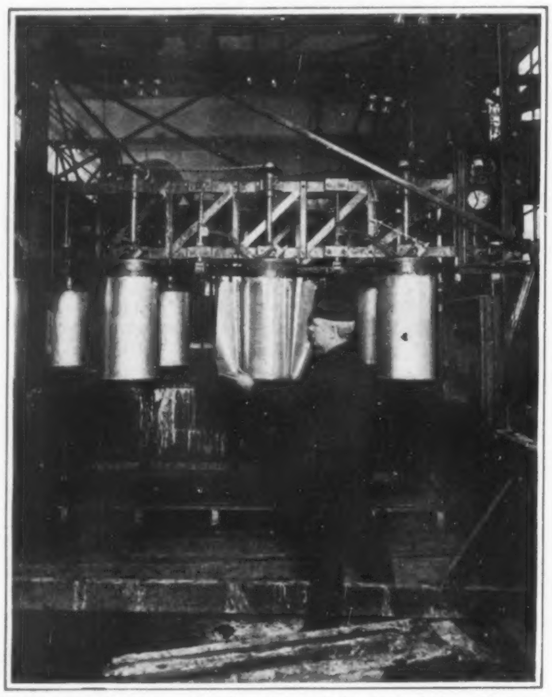
An Automatic Stabilizer.—Patent No. 1,133,559 to C. U. Greeley has for an object to provide an aeroplane which shall possess inherent, automatic stability or balance independent of the skill of the operator, and which shall be entirely free from any devices requiring manipulation by the operator for that purpose. In operation the aviator sets the supporting surfaces substantially horizontal, and the propeller draws the aeroplane forward on its wheels. When sufficient speed is attained, the aviator tilts the supporting surfaces backward by means of the controlling screw, and the aeroplane rises bodily and quickly, since all the supporting surfaces are suddenly, rather than gradually, placed in position of their maximum lifting power.

Firing Between the Propeller Blades.—It is said to be quite a trick to operate a machine gun from an aeroplane, as must be constantly done from the military aeroplanes in the war region; but it is often desirable to fire directly ahead, which seems impossible with a tractor machine on account of the liability of putting the propeller out of commission. It is reported, however, that a German inventor has devised a scheme for gearing up the trigger of the quick-firer with the engine in such a manner that when a propeller blade is in line with the gun a lock prevents a shot from being fired until the blade has passed out of range. This appears to be a most uncertain operation; but it is stated that R. Garros, the noted French flyer, has a secret method of his own by which he successfully performs the feat.

Sky Periscopes.—In the cities of Europe that are liable to be visited by Zeppelin air ships the watchers on the lookout for raiding craft have suffered from stiff necks, and also eye strain from long continued gazing at the heavens to detect hostile aircraft, and to meet this difficulty opticians have devised a special form of sky periscope. This instrument is constructed on the same general principles as those used by submarines, and the type that has been so widely adopted for use in the trenches on land. The device is a simple arrangement of mirrors that the watcher can hold in his hand, and which enables him to scan the entire vault of the sky while looking down in a convenient and natural position. It has been found so convenient that a much better and more constant lookout is maintained.

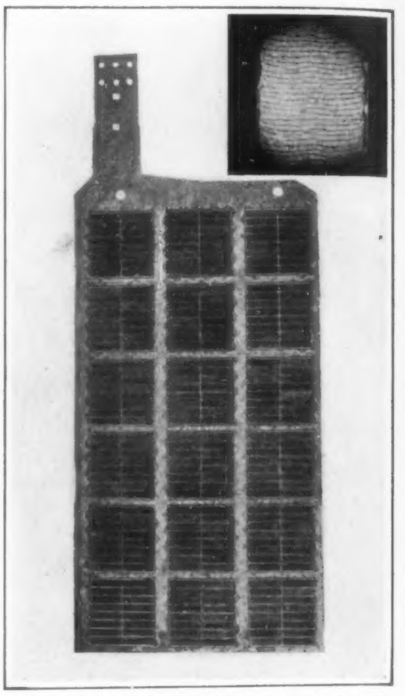


Positive plate containing tubes of flaked nickel. Note spacing strips in front of the plate.



Stripping off the electro deposited sheet 1/64th inch thick. 250 layers of copper and nickel, from which the copper later is dissolved.

Positive tube.



Negative plate; also magnified sectional view of a loaded tube.

Edison submarine boat storage battery.

Marconi's Wireless Telephone

By J. Andrew White

A FLEET of war vessels going into action with the admiral transmitting orders to his captains by word of mouth is the latest wonder promised in wireless communication. Following many rumors that a practicable wireless telephone was being quietly developed by Marconi, definite announcement has just been made that the Italian Navy has adopted the instrument and the British Admiralty has been conducting tests aboard English vessels. One instrument has already arrived in this country and communication has been established between New York and Philadelphia.

How great will be the distances spanned is not yet definitely stated, but it is reported that Marconi has expressed confidence in his ability to transmit audible speech across the Atlantic by multiplying the power and modifying the design of the present apparatus. It is possible that this feat may be accomplished when foreign conditions are again adjusted to normal. It would not be, as generally reported, wholly a scientific demonstration, for recent developments have given to transatlantic wireless telephony apparatus that would make it commercially practicable under ordinary business conditions. The short distance wireless telephone, however, will not wait for the end of the war. It is expected to become available for commercial use within a few months and will have a guaranteed range of at least thirty miles between ships at sea carrying aerials 100 feet high and with 200-foot span between masts.

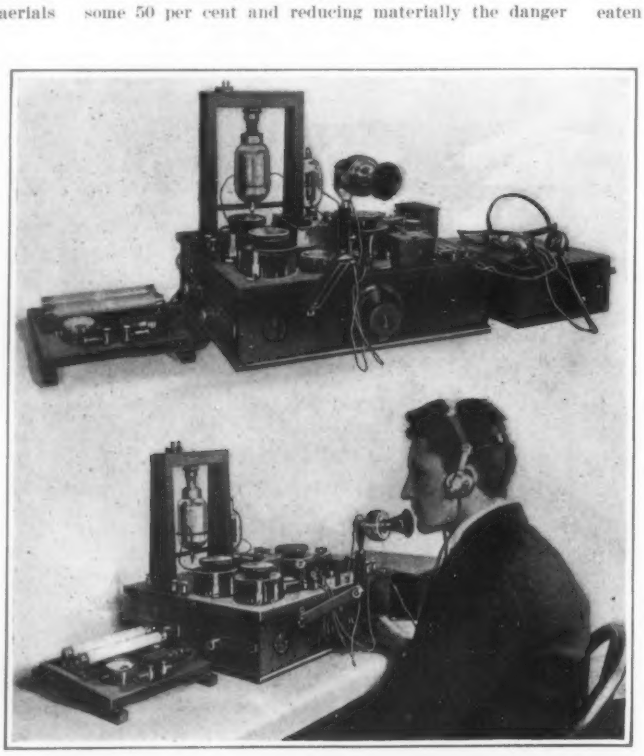
Unlike the wire telephone with its slight diaphragm distortions of the voice, the wireless instrument reproduces remarkably clear speech, and, if preferred, speech of equal quality but considerably stronger than that obtained with the wire telephone.

The wireless transmitter consists of a specially constructed valve which controls the current and is shunted with condensers and self-induction coils so as to produce a continuous stream of oscillations. The frequency of these oscillations is controlled through the variable ebonite condensers, shown in the illustration in front of the transmitting valve. The oscillations of wave energy produced by the valve being continuous, of high frequency and of constant amplitude, no sound is heard in the receiver, even if the latter is placed but a hundred yards away.

The variation required to transmit the tones of speech is secured by means of a microphone or sound magnifier, a method of connection with which permits this instrument and the receiving telephone to be placed in the captain's quarters or chart room while the apparatus itself remains in the wireless cabin. The change-over switch may also be controlled from a distance and with one operation it switches the instrument from talking to listening position.

An 80-ampere hour accumulator is provided for the low voltage current used to heat the filaments of the valves and four cases of dry cells connected in series give the high tension 500-volt current necessary for the vacuum of the transmitting valve. The usual value of the vacuum current being from 10 to 20 milliamperes it is sufficiently small to make practical the use of dry cells for intermittent purposes.

Through tuning, as in wireless telegraphy, it is possible to select the particular receiving station wanted, and adjusting to the series of waves emitted, exclude all other stations which happen to be sending within the range of influence at the same time.



The Marconi wireless telephone.

Edison Submarine Boat Storage Battery

By Herbert T. Wade

THE extensive use of submarines in naval warfare has directed attention to their weakness as well as their strength and usefulness, emphasized perhaps by the recent and tragic disabling of the United States submarine "F-4" in Honolulu harbor, with the loss of its crew. A submarine, when operating below the surface, naturally cannot make use of a gasoline internal combustion motor to drive its propellers, but employs electricity from a storage battery; therefore, any improvements working for increased power and efficiency in the storage battery must act to the advantage and safety of the submarine, increasing both the facility of its operation and its radius of under-water action from its present limits of about 100 miles by some 50 per cent and reducing materially the danger of asphyxiation of the crew. In a submarine, economy of weight and space, contamination of breathing air, the necessity for ventilation, care of the cells, and the durability are peculiar and special considerations. Until quite recently, the type of accumulator employed was the familiar lead-sulphuric acid storage battery with tandem plate, open-jar construction, with hard rubber cells, housed in a lead-lined battery tank. With such an arrangement not infrequently the electrolyte would be spilled, and so care is exercised to prevent the angle of diving from running much over 15 degrees, and to maintain as level a keel as possible to avoid spilling the acid, for should there be a break in the lead tank, the sulphuric acid would straightway attack the steel plates of adjoining ballast or fuel tanks or bulkheads. Furthermore, in the presence of sulphuric acid, seawater is decomposed and chlorine gas with its dangerous fumes is produced; while the acid attacking the gasoline fuel tanks, naturally may lead to the escape of gasoline. Both the chlorine fumes and gasoline vapor are not only disagreeable, but positively dangerous. Thus on the United States submarine "E-2" in the autumn of 1914 while at sea on her way from Newport News to New York, the escaping chlorine fumes seriously affected the crew despite prompt measures for their relief. About the same time, when the battery tank of one of the D submarines was inspected, it was found to contain gasoline in substantial and dangerous amounts as a result of the fuel tanks being eaten away by acid. Consequently, the elimination of lead-sulphuric acid storage cells on a submarine, and their replacement by a battery, where the electrolyte does not attack, but actually preserves steel, and where the electrolyte can be mixed with seawater without dangerous effect, is naturally a distinct advance and advantage.

The fundamental principle of the Edison storage battery as now being installed on a United States submarine, in which these advantages are realized, is the oxidation and reduction of metals in an electrolyte which does not dissolve the metals and will not combine either with them or their oxides. This electrolyte when decomposed by the action of the battery is immediately reformed in equal quantity, and unlike the sulphuric acid solution, is, therefore, practically constant, without change of density or conductivity over long periods of time. The active elements of the battery are nickel and iron, employed not in the form of metal, but as nickel hydrate and iron oxide, carried in perforated pockets or tubes. The electrolyte is a 21 per cent solution of potassium hydrate, with a small amount of lithium hydrate added. As only a small quantity of the electrolyte is necessary, this permits a very close proximity of the plates.

Where the Edison storage battery exhibits special adaptability and advantage for use on submarines is in saving weight; being much lighter than other batteries of equal capacity, so that this difference can be applied to pig-

(Concluded on page 461.)

What Is Matter Made Of?

Resemblance of the Atom Structure to an Infinitely Small Solar System

By Arthur H. Compton

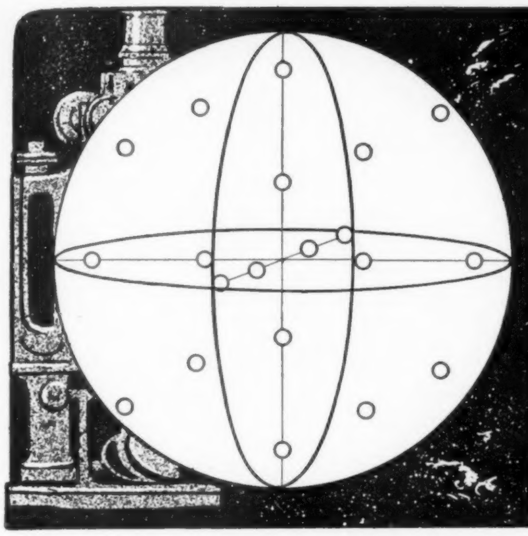


Fig. 1.—Diagram illustrating Lord Kelvin's theory of electrons.

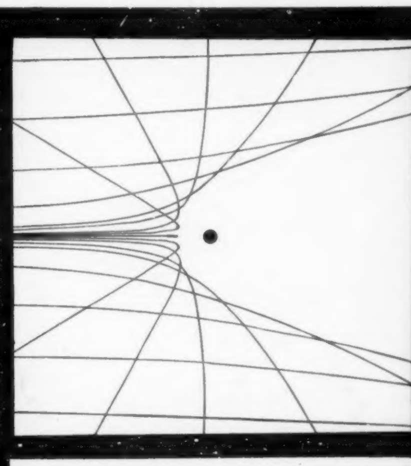


Fig. 2.—Paths of alpha particles in relation to a positive nucleus.

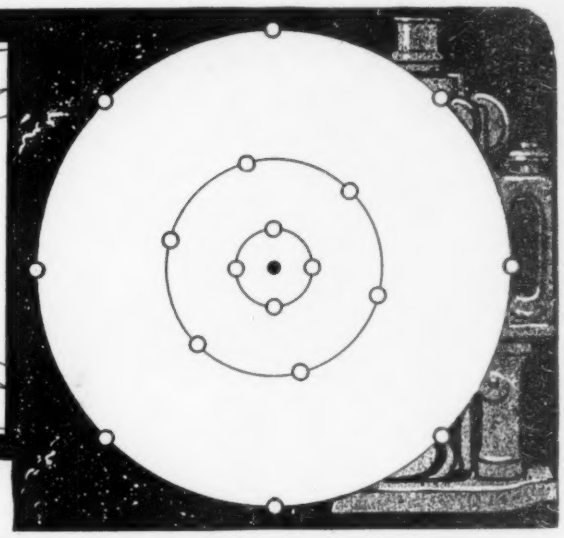


Fig. 3.—Diagram illustrating Prof. Rutherford's idea of an atom.

BY the general acceptance of the molecular theory of matter and of the combination of atoms into molecules the scientists of the last century made a long step toward the solution of that greatest of physical problems, the constitution of matter. It has remained for the scientists of the present century to probe still deeper and investigate the structure of the atom itself. For a long time the atom was considered to be the ultimate unit of matter. Not until the demonstration of the existence of the electron, at the dawn of the present century, was matter suspected of being still further divisible. The discovery, however, of a particle one eighteen hundredth the mass of a hydrogen atom, showed that not even the atom could be a unit, but must be a system of some sort. Ever since this discovery it has been recognized that the atom must be explained in terms of electricity. The problem has been to devise a model, made up of electrons and sufficient positive electricity, which will have the properties an atom is known to possess.

The construction of such a model atom is complicated by the fact that, though a natural unit of negative electricity is known in the electron, no corresponding unit of positive electricity has ever been found. It is true that very small positively charged particles are known, such as the alpha particles which are given off by radium, and the positively charged particles in "canal rays," but these, instead of carrying a charge equal to an electronic unit, carry, in general, some multiple of that charge. It is this positive charge in the atom that has been hardest to explain, and about which the discussion has chiefly centered.

There have been a large number of explanations offered, but the first of value was that of Lord Kelvin. His idea was that the positive electricity is uniformly distributed throughout a sphere whose radius is the radius of the atom. The electrons move about within this sphere under the attraction of the positive electricity and the repulsion of the other electrons, as in Fig. 1. This model is particularly interesting because the attraction of the electrons toward the center of the sphere varies directly as their distance from the center, just as the weight of a body within the earth's crust is proportional to its distance from the center of the earth. It was on account of the simplicity of the mathematical representation of an atom with this law of force that Lord Kelvin suggested such a model. He did not intend it to represent the actual structure of the atom, so we are not surprised to find that recent experiments show this model to be impossible.

The other most important model of an atom has been suggested by Prof. Sir Ernest Rutherford. He imagines an atom to be built up like a solar system on an extremely small scale (Fig. 3). The positive electricity is concentrated into a very small nucleus, which takes the place of the sun, and the negative electrons revolve about this like planets. It seems probable that they are arranged in rings, like the rings of Saturn. The extreme simplicity of such a model is a strong point in its favor if it will work. At a lecture before the Physics Colloquium at Princeton, Prof. Rutherford gave an interesting summary of recent experiments which have given evidence as to the structure of the atom.

Fig. 4.—Paths of alpha particles through watery vapor.

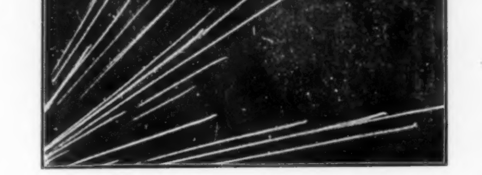


Fig. 5.—X-ray spectra of ten metals, according to Moseley.

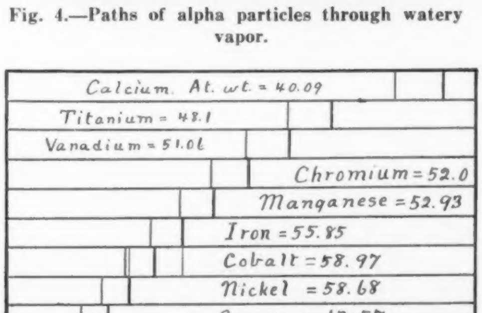


Fig. 6.—Paths of alpha particles.

These experiments have not only supported his theory, but they have enabled him to count the number of electrons in the atoms of the different elements and to tell some of the properties of the positive nucleus.

Possibly the most striking confirmation of his theory of the atom comes from the passage of alpha particles through matter. Alpha particles are the positively charged corpuscles shot off with extremely high velocity by radio-active substances. They are given off with a certain definite velocity, about a fifteenth that of light, and will travel through a definite thickness of gas, or even through a thin piece of solid matter. Fig. 4 shows some remarkable photographs obtained by Prof. C. T. R. Wilson, showing the paths of these particles through water vapor. It may be seen that as they pass through the vapor the greater part of their path is straight. It can easily be shown, however, that during this motion the particle must pass through myriads of atoms. Now an alpha particle is known to unite with two electrons to form a helium atom; it is, in other words, a helium atom with a double positive charge. So if we consider the atom to be continuous spheres of definite diameter, as these positively charged helium atoms pass through the atoms of vapor we have the extremely interesting phenomenon of two different bodies occupying the same space at the same time. In order to account for the fact that these particles pass through such long distances without being moved from their path by collisions it is necessary to conclude that both the alpha particles themselves and the centers with which they collide shall be very small—much smaller than the atom itself. We are therefore limited to the idea that the charge must be concentrated on a very small nucleus. Let us see what we can find out about the properties of this nucleus.

In order to place an upper limit upon its diameter an experiment was tried to see how close the alpha particles could come to the centers of collision in the atoms. When these particles are discharged onto a solid surface most of them are absorbed, but a small proportion are reflected from the surface, some of them straight back from the way they came. It is as though a gunner were shooting at a target until it was riddled with holes, when suddenly a bullet would bounce back at him with almost its original velocity. The gunner would probably be surprised enough to hunt the reason for this unusual event. It is none the less surprising that these little particles should rebound, for these projectiles strike the target at ten thousand miles instead of a few thousand feet per second, and only one in thousands is reflected back on its course. There must be some powerful force acting which will cause such a sudden change in velocity.

This force is found to be none other than the electric repulsion between the positively charged alpha particles and the positive nucleus of the atom. As in Fig. 2, if the particle passes at a noticeable distance from the nucleus, its course is not changed because of its high velocity, but if it comes very near, it is deflected away in a hyperbolic curve. By measuring the number of alpha particles which are scattered at different angles by different substances, it is possible to calculate both the forces acting and the distances between the two positive charges when they are closest together. It is found that if each nucleus is given a mass of an ounce, on this scale their centers would come closer than half a thousandth of an inch of each other, and the electric

repulsion between the two particles would be in tons one with thirty-four ciphers after it. No wonder the particles fly away from each other with such terrific speed after a collision! The forces acting indicate that there is a positive charge on the nucleus of the atom equal to about one half the atomic weight, measured in electronic units. Thus the heavy elements have a greater charge on their positive nuclei than have the light ones. But possibly a still more interesting deduction is that in an extreme case, when the nuclei of two hydrogen atoms collide, the distance between their centers is considerably less than the diameter of an electron. We must conclude, therefore, that the nucleus of the hydrogen atom, though much heavier, is considerably smaller than an electron.

Let us consider the charge on the nucleus from another standpoint. In a recent article in the SCIENTIFIC AMERICAN SUPPLEMENT I described some remarkable photographs taken by Mr. H. G. J. Moseley, showing the X-ray spectra of a number of different elements. Fig. 5 shows the spectra of the rays given off by some of these elements when used as the target of an X-ray bulb. The most striking thing about these photographs is the remarkable similarity of the spectra of the different elements. It will be seen that the wave-length of the rays increases uniformly as we pass from the heavier to the lighter elements. This, of course, corresponds to a decrease in the frequency of vibration. In fact, Mr. Moseley showed that the square root of the frequency corresponding to the more prominent line in these spectra changes by a constant difference as we pass from element to element in the order of their atomic weights. It is the inner ring of electrons in an atom, such as shown in Fig. 3, whose vibrations cause the lines shown in these spectra. The greater the charge on the nucleus the more firmly are the electrons held in their orbits, so that they naturally vibrate with greater rapidity. So this regular increase in frequency is easily explained if we consider the atomic nucleus of each element to carry a greater electric charge than the nucleus of the element next lighter, which is in accord with what we found by the scattering of alpha particles. By a little calculation it is easy to show that, in order to account for the shift in these spectral lines, the charge on the nucleus must change by one electronic unit as we go from one element to the next. There are a good many reasons for believing that the charge on the nucleus of a hydrogen atom is one, so that the charge on the positive nucleus of any element is Ne, where N is the number of the element in the order of atomic weights counting hydrogen as one, helium as two, etc., and e is the electronic unit of electricity. For the electrically neutral atom this of course means that there are N electrons revolving about the nucleus. Thus, if zinc is the thirtieth element, the charge on its nucleus is $30e$, and there are thirty electrons revolving about the nucleus in orbits. This is in good agreement with what we found by the scattering of alpha particles, that the charge on the nucleus is equal to about half the atomic weight of the element, for the atomic weight of zinc is 65, which would make the charge on its nucleus about $32e$.

The determination of the mass of the nucleus presents no difficulty. The mass of the whole atom is well known, as is also that of the N electrons which are revolving about its nucleus, so that of the nucleus is simply the difference between the two. The mass of the electron is so small, however, that the nucleus may be taken to possess the whole mass of the atom without sensible error.

The accurate estimation of the size of the nucleus carries with it an explanation of the mass of the atom. If we take the hydrogen atom as the simplest example, the charge on the nucleus is $+e$. So, in order that it shall be electrically neutral, the atom must contain one electron. The mass of the electron is, however, electrical in nature. That is, when it moves it acts like an electric current whose self-induction gives it a kind of inertia. By making the wire which carries a current fine enough it can be given any desired amount of self-induction, and similarly, if a charged particle is made sufficiently small, it can be given any desired amount of electric inertia or mass. But it seems very improbable that the mass of the atom should be of two kinds, partly electrical and partly of some different, unknown nature. So as we know that at least a part of its mass is electrical, it seems only reasonable to explain the rest in the same way. In order to do this it is only necessary to assign to the hydrogen nucleus a diameter of one eighteen-hundredth that of the electron, and on account of the extreme minuteness of the nucleus as shown by collisions with alpha particles, this does not seem improbable. It is easy to see how the nuclei of heavier atoms might be made up of a group of these hydrogen nuclei, and still act as point charges when battered by alpha particles. In this way the mass of all matter is explained as due to the well understood phenomenon of electro-magnetic induction.

We have thus not only determined the charge on the nucleus of the atom, but from a knowledge of its mass we have estimated its size as well. For a hydrogen atom these quantities are approximately:

Charge on nucleus $= e = 4.7 \times 10^{-10}$ e. s. units,
Mass of nucleus $= 1.6 \times 10^{-24}$ grammes,
Radius of nucleus $= 1.0 \times 10^{-16}$ centimeters.

Knowing the size and mass of the nucleus, we find its density to be 3.8×10^{23}, which is inconceivably greater than that of the heaviest element. In order to form an idea of what these figures mean, let us construct a model of an oxygen atom on a large scale, considering its nucleus to weigh a ton. As its atomic weight is sixteen, we may expect its nucleus to contain sixteen hydrogen nuclei. These will be represented by positively charged particles, each weighing over a hundred pounds, but so small as to look like the finest dust. Since oxygen is the eighth element in the order of atomic weights, its nucleus will have a positive charge of eight, so the nucleus will contain also eight electrons, which will neutralize half of the sixteen positive charges. These electrons will be represented by grains of fine sand, each weighing an ounce, and the whole nucleus will be a very small fraction of an inch in diameter. Of the eight electrons revolving about the nucleus, the inner ring will be similar grains of sand traveling with tremendous speed at a distance of a few inches, while the outer ring will be at a distance of several feet. The nucleus of the other atom of the oxygen molecule will be a yard away, and the next molecule of the gas will be about a rod off. Looking at it in another way, if a hydrogen nucleus were as large as the sun, the nucleus of the next atom would be at the distance of one of the nearer fixed stars.

Besides giving us a great deal of definite information as to the structure of the atom, these investigations have opened up new lines for study. What is the force

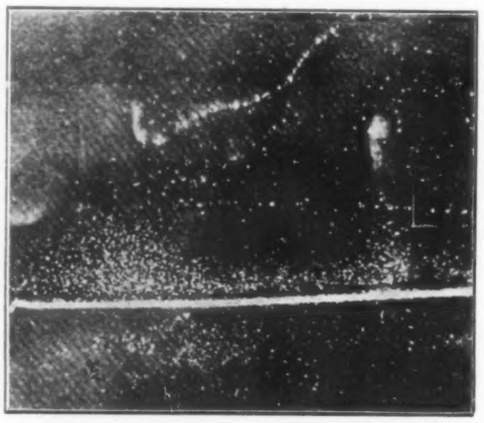


Fig. 7.—Path of an alpha particle.

which binds together the different parts of the nuclei of the heavy atoms? Is it not possible that the tremendous energy of a radioactive discharge may be explained as due to the instability of this force in complicated atoms? What arrangement of the electrons about the nucleus will explain the physical and chemical properties of the atom as we know them? Questions such as these we may expect to have answered in the near future now that we have a definite idea as to the general structure of the atom.

Chlorine Gas on the Battlefield

In the evolution of warfare there has been continuously an increasing use of forces farther and farther from the direct use of muscular power. This is the same line of progress as that shown in industrial development. An increased use of machines, the applications of physical forces as they become known through scientific study and in general the gradual substitution of natural forces controlled by mind for the muscular exertion of earlier times.

Many of the operations of war are the same in their essence as those of peace; the organization of transportation, the supplying of food and water, transmission of intelligence by all sorts of methods, the application of sanitation and medical service and many other activities of war are similar to those of peace and they call upon all available knowledge of mechanics, physics, chemistry and bacteriology.

The methods of destruction also call upon knowledge from most of the arts and sciences, and each step in their evolution is a further application of scientific knowledge.

In the present European war the application of such knowledge seems to be reaching the utmost limit of ingenuity. It may almost be called a chemist and physicist war with its application of physics in aerial navigation and its use of submarines, of telephones, wireless telegraphy, searchlights, and range-finders, and the application of chemistry in the manufacture of its many explosives, the manufacture of hydrogen for airship, its illuminating bombs and flares and latest of all in the manufacture of poisonous gases to be used for tactical purposes.

The reports which have been received seem to show that the gas so far used is chlorine. The greenish yellow color, the strong smell, the great density of the gas causing it to flow along the ground are indications of chlorine. The symptoms shown by its victims are those exhibited by persons who have been poisoned by chlorine in industrial accidents; that is great irritation of the mucous membranes, bronchitis, and sudden death by a narcotic action in the most severe cases.

If chlorine is the gas which was used, it must have reached the trenches in a concentrated form to cause death unless the death was due in part to psychological effects, for to produce death rapidly it is necessary that the air breathed shall contain at least one part of chlorine in 1,000 of air. Long exposure to air containing 1 part of chlorine per 100,000 is dangerous and even smaller amounts are troublesome.

It is of some interest to know how much chlorine is needed to be effective. On the supposition that there is a breeze of 4 miles per hour and that it takes two minutes to empty the containers holding the chlorine, the drift of air during that time would be about 700 feet, to charge the lower three feet of this air current with chlorine to a concentration of 1 to 1,000 would require about 6 cubic feet, or one pound for each yard, or something like one ton per mile of battle front. Chlorine can be obtained commercially compressed into liquid form in cylinders for 5 to 8 cents a pound, and as a by-product in the electrolytic manufacture of hydrogen for balloons it may well be of less value.

Under proper conditions then it is quite feasible to use this inexpensive and powerful offensive weapon. But the conditions must be right. Too strong a breeze would diffuse the gas, a variable wind or calm would injure the user. It would hardly be safe to use the gas unless the battle line were straight or convex toward the enemy since otherwise the fumes would be apt to drift in part over the users' own lines.

And then undoubtedly effective preventive or antidotal measures can be used. A sponge or towel wet with water or better with some basic substance like cooking soda or borax kept ready to put over the face might hold off the danger and more special respirators charged with basic substances or with reducing agents like oxalates or sodium hyposulphite might enable the attacked force to tide over the worst of the attack.

There are several other poisonous gases besides chlorine which might be used, of which the following may be mentioned: hydrocyanic acid, sulphur dioxide, arsine, carbon disulphide, hydrogen sulphide, the oxides of nitrogen and bromine vapor. From the field of organic chemistry could be taken the cacodyl compounds and the isocyanides.

Since several of these do not act at once they are probably not suitable as the effect to be produced is not so much actual poisoning as the forcing of an opening for an attack in the ordinary way. Some of them are too light to flow readily along the ground and are less suitable.

Probably sulphur dioxide and bromine might be used in a similar way to chlorine as they are extremely irritating, act at once, and are heavy. But they could both be absorbed by respirators similar to those effective for chlorine. Sulphur dioxide is colorless, and on that account not to be detected by the eye, but it is not as dangerous as either chlorine or bromine.

While the use of poisonous gases has been spoken of as in the line of evolution of warfare, since it is an application of advanced knowledge, the thought comes that in view of the apparent cruelty involved it can be used only when it is shown to be of great military value. It has been apparently of some military value temporarily, and is used against military forces and not against non-combatants and in that sense is perhaps more allowable than the dropping of bombs in cities or the bombardment of undefended towns, but the weapons which seem most in line with this use of gases in war are the saw-toothed knife, the jagged spear, and the dum-dum bullet. With the perfection of preventive measures the tactical advantages may be removed and this barbarous application of scientific knowledge may not tempt the leaders of armies of so-called enlightened nations.

Cannibalism Among Foxes.—The cannibalistic tendencies of foxes have proved a serious drawback to the valuable fox-raising industry of Prince Edward Island, according to a recent consular report. Not only are the pups frequently eaten by their parents, but females are sometimes killed and partially eaten by their mates. As the adult animals may be worth several thousand dollars a pair, this is a serious matter. A remedy is found in the filing down of the canine and bicuspid teeth of the male fox; this gives the female such an advantage in a fight as to insure her safety, and also minimizes the danger of the teeth of the parent fox being caught in the skin of the pups when playing with them, giving him a taste of blood which tends to make him want more.

Lessons of the Present War From a Technical Point of View

By Hudson Maxim

THE main lesson of the present war is the importance of insurance against war by scientific preparedness, especially preparedness with the machinery of war, and preparedness with men trained to the use of that machinery. This is an age of machinery, where hand-labor is largely replaced by labor-saving mechanism. Labor-saving machinery applies to the work of war in just as large measure as it does to peaceful industries.

The lesson second in importance is that, after war comes upon a nation, there is no time to equip for the fray, and even if there were time it is not the right time, for the tremendous extravagance of preparing for war under the pressure of war is amazing.

Not one of the Allies in the present war was adequately prepared for the war. By consequence, it is necessary for them to pay most extravagant prices for all kinds of munitions of war. Had England, France, or Russia spent one quarter of what this extravagance has cost them during the present war, in preparedness before the war, there would have been no war, and even had war come they would have been able to carry on the war without this great extravagance, and northern France and Belgium would not to-day be within the German lines.

Even had little Belgium prepared herself for this war as adequately as Switzerland keeps herself constantly prepared, she would have been able not only to retard the march of the Germans, but also to have held them back until support came from her allies.

England and France had pledged themselves to stand by Belgium. They should have been adequately prepared to defend that pledge by force of arms.

The lesson of the war next in importance is the fragility of treaties. Of course, all history has taught this lesson. It is a lesson that has been repeated in every generation. But it has been given such impress upon the minds of men of this generation that it is not likely again to be forgotten for the next century. The fact is, and all history supports the conclusion, that nations know no law but necessity, and can be made to obey no law except necessity, in time of war. The only way that international treaties can be made binding is for the majority of the nations of the world to sign them, and pledge themselves unitedly to support them and enforce them. Then no one nation would dare to break a treaty, because by so doing she would bring a world in arms against her. She would, even then, be governed by her supreme necessity, because the necessity of observing the treaty would be greater than any other necessity.

I have treated upon the lessons of the present war at considerable length in my recent book, "Defenseless America," to which I respectfully refer the reader. Within the limits of the present article I can merely touch upon the main points.

The next important lesson of the war is the unreliability of all prophecies of the pacifists who have told us for the past quarter of a century that human nature had so much improved in recent years, and international brotherhood had become so dominant, and civilization of such a high order had arrived, that the nations were not going to war much more.

We all well remember the famous book of M. de Bloch, published near the close of the last century, in which he predicted that the last great war of the world had been fought; that war with modern enginery would be suicide to the countries engaged. It was this book that led the Czar of Russia to call the first Hague Conference to consider the disarmament of the nations.

Since the publication of M. de Bloch's book there have been the English-Boer war, our war with Spain, the revolution in China, the Russo-Japanese war, the Italian-Tripoli war, two Balkan wars, a continuous guerrilla warfare in Mexico, and now we have the great European conflict. Surely, there has not been much shortage in wars.

Even a few months before the present war broke out, Dr. David Starr Jordan made the following announcement in his book, "War and Waste":

"What shall we say of the great war of Europe, ever threatening, ever impending, and which never comes? We shall say that it will never come. Humanly speaking, it is impossible.

"Not in the physical sense, of course, for with weak, reckless, and godless men nothing evil is impossible. It may be, of course, that some half-crazed archduke or some harassed minister of state shall half-knowing give the signal for Europe's conflagration. In fact, the agreed signal has been given more than once within the last few months. The tinder is well dried and laid in such a way as to make the worst of this catastrophe. All Europe cherishes is ready for the burning. Yet Europe recoils and will recoil even in the dread stress of spoil-division of the Balkan war. . . .

"But accident aside, the Triple Entente lined up against the Triple Alliance, we shall expect no war. . . .

"The bankers will not find the money for such a fight, the industries of Europe will not maintain it, the statesmen cannot. So whatever the bluster or apparent provocation, it comes to the same thing at the end. There will be no general war until the masters direct the fighters to fight. The masters have much to gain, but vastly more to lose, and their signal will not be given."

This is a strange prophecy in view of what immediately followed it. Verily, "Who is this that darkeneth counsel by words without knowledge?" (Job, xxxviii, 2.)

There is one other important lesson which I will mention before closing, and it is, that nothing like as many men are killed in the present war as was predicted. This war does not mean international suicide, and the expense does not mean international bankruptcy.

The total number of inhabitants of the countries engaged is about 500,000,000, without counting more than a small part of the great population of India, and the total number killed and wounded during the present war, even if put at 800,000, would be 1,000,000 a year less than the birth rate, while the total number killed, if taken at 800,000, would be less than one sixth of the birth rate. Even if we put the cost of the war at the high amount of $15,000,000,000 for one year, it would be only 5 per cent of the warring nations, because their wealth is about $300,000,000,000. As most of the money is expended by the nations within their own frontiers—in other words, spent at home—the actual out-of-pocket loss is nothing like $15,000,000,000, or 5 per cent.

If the present war should by any possibility end in a draw, it is very likely that each of the warring nations would be stronger in men and means at the end of the war than they were at the beginning. Spain greatly benefited by her war with us; we benefited greatly by our war with Spain. The Boers of South Africa have much to thank England for, for her victory over them, while England is better for the fight. Japan was greatly vitalized and benefited by her war with Russia, and Russia was even more benefited than was Japan.

At the end of the first Balkan war we were told that Serbia was utterly exhausted, yet she was able to beat Bulgaria in a most desperate war. Again we were told that she was utterly at the end of her men and resources; consequently, when she was invaded by Austria in the present war, and the invaders were driven out with great discomfiture, it came to us as a surprise.

While we may rightly deplore war, we must recognize and admit its advantages as well as its disadvantages; otherwise we wrong ourselves by deceiving ourselves.

If we were to admit, with the ultra-pacifists, that there was never a good war nor a bad peace; that all wars are bad and injurious; that every war since the beginning of time has been a calamity, then we have all the more reason for adequate preparedness against so dread an eventuality; and we know, if we know anything in this world, that there is only one way to prepare against war, and it is with guns and trained men behind the guns.

The Current Supplement

IN the current SUPPLEMENT of the SCIENTIFIC AMERICAN, No. 2054, for May 15th, 1915, there is an illustrated description of an Exposition of Military Sanitation in Berlin, which tells many interesting things about the methods followed by the Germans in handling and treating the wounded in the present war. Another interesting illustrated article gives facts in relation to the culture of hemp in this country. The extremely valuable paper on The Submarine in Naval Warfare is concluded, and contains several appropriate illustrations. The Pathology of Mental Disorders is dealt with in copious abstracts from a very comprehensive paper on this important subject. Another article of general interest tells many things about commercial glucose and its uses. This is a material that is of wide interest, entering as largely as it does into many food products, and one that is generally misunderstood. Salts colored by cathode rays discusses an interesting phenomenon and offers some explanation. Mutations and Modifications of Bacteria treats of a subject that is of importance in regard to the proper recognition of species and kinds, and their derivation from one another. There is a story telling about the production of a new food from dried beer yeast in Germany; a short discussion of what electrical engineering has done for human progress and efficiency; and last, but not least, there is another of the series of lectures on Atoms and Ions, by Sir J. J. Thomson.

Proposed Zoological Survey of India.—At the suggestion of the trustees of the India Museum, the government of India contemplates establishing a Zoological Survey analogous to the existing Botanical and Geological Surveys of that country, and based upon the existing zoological and anthropological section of the museum.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Mr. Edison on the Edison Fire

To the Editor of the SCIENTIFIC AMERICAN:

The Detroit Brick Manufacturers' and Dealers' Association is distributing throughout the United States a pamphlet entitled, "The Edison Fire."

The results of the fire at my plant on December 9th, 1914, were these: Of the seven reinforced concrete buildings none were destroyed. A small section of the upper floor of one of the buildings fell in, but was supported by the lower floors. The pamphlet referred to presents three views of this, the suggestion being that they were of three different buildings. The brick administration building to which they refer, which remains standing, was protected by an adjacent concrete building and was not subjected to the fire.

Every brick and steel building which was attacked by the fire was completely destroyed, together with all the machinery they contained, while the damage done to concrete buildings amounted to about 12½ per cent, and of the machinery contained in the concrete buildings 98 per cent was saved and is now in operation. Manufacturing was resumed in some of the old concrete buildings within a few weeks after the date of the fire.

Temperatures were far in excess of those in the ordinary fire, but reinforced concrete showed its superiority over any other fire resisting material.

The millions of dollars of fire losses in this country annually make it a matter of moment that the superiority of reinforced concrete for fireproof structures should be thoroughly understood, and it is for such purpose that I have written this letter. THOS. A. EDISON.

Orange, N. J.

Vacuum Gasoline Feed for Automobiles

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to point out an error in your issue of April 24th, which occurred on page 386. You say, speaking of the vacuum gasoline feed system for automobiles, "at this angle no pressure system could possibly force gasoline to the carbureter."

Gasoline is, roughly, one half as heavy as water or four feet head for every pound of pressure. The usual pressure system maintains two pounds, but a readily made adjustment will cause them to maintain three or four. This means eight, twelve, and sixteen feet, respectively. The case illustrated is not raised above six or seven feet. E. PAUL DU PONT.

Montchanin, Del.

Defenselessness of the United States

To the Editor of the SCIENTIFIC AMERICAN:

I desire to express my hearty approval and appreciation of the most timely and instructive series of articles regarding the defenselessness of the United States now appearing in the SCIENTIFIC AMERICAN. Yet it is to be feared that all efforts to awaken the American people from their chronic condition of apathy and indifference concerning this most vital of all questions will prove futile. Nothing short of the shells of an enemy bursting in our midst will have any result.

To the writer it does not appear that the defenseless condition of the United States is solely chargeable to Congress. Congress reflects the attitude of the majority of the people, which is an easy-going "it-will-all-come-out-right-in-the-end" sort of optimism, always ready to "take a chance."

We should not overlook those imbeciles who profess to believe that we should put our trust in "moral force," whatever that is. Backed by connection with this or that university, the Church or the State, and closing their eyes to realities and their ears lest they should hear aught save the reverberation of their own voices, they harangue of airy ideals and millennial dreams.

The fact that we rigidly exclude the Chinese, who have nothing but this much-vaunted "moral force" supporting their demands for admission, while we allow the Japanese, who possess, alas, carnal weapons—a navy, an army, and guns—to regulate their own entrance into this country under the so-called "gentlemen's agreement," should be sufficient reply to the arguments of traitors of this type.

In conclusion, let me state that when the enlisted man is no longer regarded with thinly veiled contempt, when he ceases to be regarded by the people generally as a necessary evil, one may venture to hope that they are emerging from their fools' paradise.

San Francisco, Cal. JOHN H. GREEN.

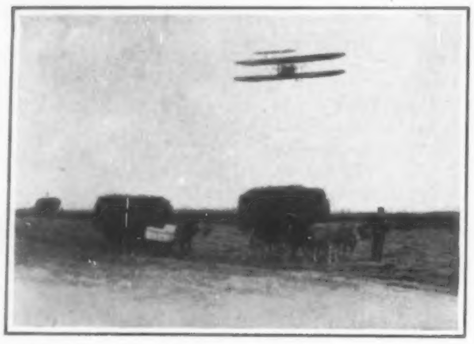


Fig. 2.—A popular "Time trick photograph."

The landscape was made at one time, the aeroplane at another, and printed into the sky.

Fig. 3.—Memories of other days.

A scene made by printing in from two separate negatives, made at different times.

Motion Picture Magic

Playing Tricks on Time

By C. H. Claudy

(Illustrated with Photographs Copyright by Thos. A. Edison, Inc.)

PHILOSOPHERS for centuries have speculated on the senses of man, and wondered why the number was five, and not six or seven or more. Literature is full of the mystic "sixth sense," which means anything the author of the moment may wish it to mean. Additional senses are popularly supposed to be those peculiar faculties which belong to the realm of psychics—second sight or inner hearing (clairvoyance or clairaudience)—but it is a fact that the everyday man has several senses beyond the five physical senses of sight, hearing, smell, touch and taste.

For instance, every one has a sense of balance. Strap a man to a board, blindfold him, and tilt the board. He will tell you unerringly whether he is head down or head up, and pretty closely at what angle he is. The aeroplanist, high in the air, knows whether he is level or tilted—yet neither learns the fact through any of his five senses.

Again, we have the sense of unconscious memory. The "bump of location," which the woodsman shares with the traveler, and by which each can find his way in strange places, is but an instance of memory of scene or street seen once before, not recalled in detail, but present in the mind, waiting to be called upon when wanted.

And we have a sense of time, most strange of all our senses beyond the usual five, least understood, and, when tricked, most prolific of wonder.

Many a railroad man learns to dispense with an alarm clock. If his call is for four-thirty in the morning, he will wake with a start at four o'clock. Many a man sets his alarm clock night after night, only to rise five minutes before it goes off, and stop it from waking the household. It is his sense of time which rouses him. Plenty of people—railroad men in the lead—can tell the hour to within a few minutes any time of the day without reference to a watch—again, the sense of time.

So accustomed are we to our mental valuation of the passage of time that when any event in our lives annuls this sense, or seems to go contrary to it, we marvel. No railroad man who has ever been in a wreck will need confirmation of the statement—he will remember how far apart the morning and the afternoon seemed, if the wreck came in between. Anything which jars us out of our daily course, which makes our minds take in new impressions rapidly, dulls our sense of time, and stretches it out, so that it seems longer than usual.

"I've had a long, long day," exclaims the man who has done much and unexpected business.

"The day was so short it fairly flew by," says the vacationist, resting at the seaside.

In the one case, the sense of time was inhibited, in the other hypersensitized—yet time was the same.

Things That Affect Our Sense of Time.

Some people have a much keener sense of time than others. For instance, the clever boxer has a *time sense* which sharpens under action so that he actually lives at a different rate than those who watch. Not more rapidly, as we might think, but more slowly. Remember, the greater the number of new mental impressions, the slower the time seems to pass. The man in the wreck lives a week in an hour—the dentist's victim, possessing a sore tooth, finds five minutes stretch to the hour. The boxer, with his hypersensitive time sense, gets a greater number of sight impressions per second than a less clever antagonist. The flying fists he dodges so cleverly seem to him to move more slowly than they would to you or me, and because they seem to move the slower, because he sees them clearly in all the path of their vicious swings, he seems to himself to have plenty of time to dodge them. The ball player with "good batting eye" has the same trick of living slower for the moment, and so getting a greater number of sense impressions—he actually sees the ball in all its swift path from the pitcher's hand, and so has time to bring his ash against it, where you and I would but try to dodge a streak of white against the green.

The action of certain drugs slows up our living, sensitizes our time sense. Opium and hasheesh fiends live days, weeks, and months of experience, in a few hours, their time sense stimulated to the last degree. Did such drugs stimulate the body and its muscles to the same degree, a hasheeshed boxer would be irresistible. But, of course, such drugs affect the body in the exact opposite from the way they trick the brain.

The magician on the stage tricks not our eyes alone, but our sense of time. With two cages in plain view, he has a woman enter one, and draws a curtain about it. After a few words, he fires a pistol, drops this curtain, and we see the cage empty, while the other cage is suddenly inhabited by the same woman. We have not seen her pass from cage to cage—we know that she could not pass instantly from cage to cage, because people don't move twenty feet in an instant. Yet she is there. Our sense of time is outraged, and the result is "magic." Could we see the woman leave the first cage by a trap, walk under the stage, and enter the second cage by another trap, there would be no trick. But we are led to

Fig. 1.—After the sixth exposure from the top the camera was stopped until the man had changed his clothes.

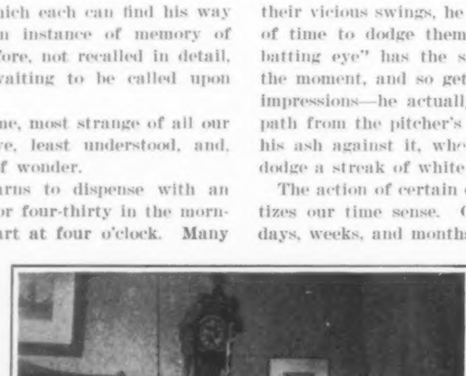


Fig. 4.—The "sheeted ghost" is a time trick, the exposure being made as usual, after which the "ghost" walks into the scene and the rest of the exposure is made. The result is that the first exposure shows through the second, giving a "ghostly" effect. Two pictures made at two different times, appear as one—hence the trick.

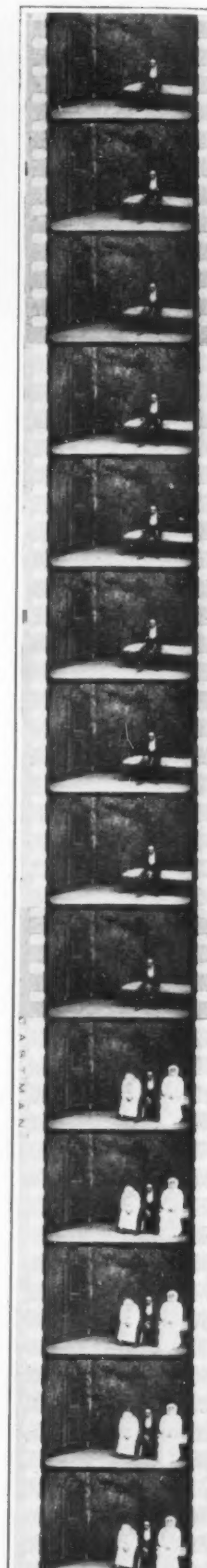


Fig. 5.—This is made in the same way as Fig. 1. While the camera is stopped the two specters come in.

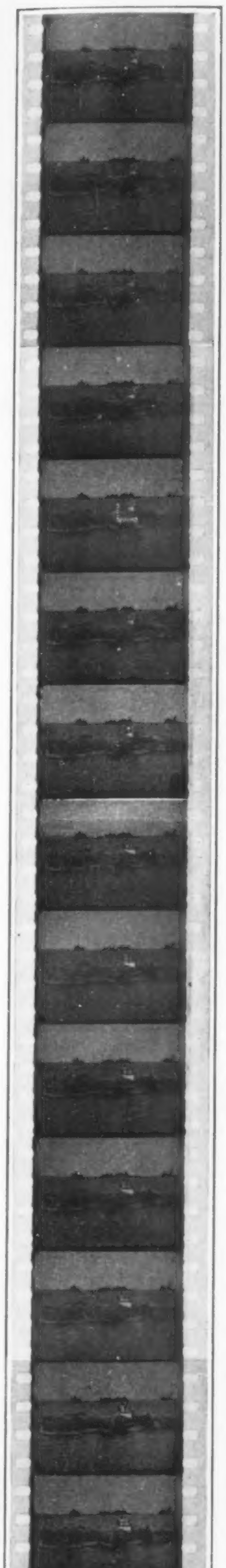


Fig. 6.—A scene made by hand. After each exposure the boat was moved forward a predetermined distance.

Fig. 7.—This shows the first scenes of the film shown in Fig. 5, with a man sitting alone in a haunted house.

Fig. 8.—In this scene the man asleep in the haunted house awakens to find a specter sitting on either side.

believe the woman is in the first cage to the *instant* the pistol is fired—it is not the mere fact of her transfer from cage to cage which puzzles us, but her *instantaneous* transfer which our sense of time says is impossible.

The Magic of the Screen.

Wonderful as is the magic of the prestidigitator, however, it is as nothing to the magic which we see upon the screen when we watch a motion picture trick film. Here, at last, is the magic of our childhood—appearances, disappearances, apparitions, objects moving without apparent cause, people, trains and animals traveling at "impossible speeds," furniture endowed with life, inanimate objects possessed of the power of movement and of intelligence, even those things which the fairy power of Grimm and Andersen brought vividly before our minds' eyes made to seem real—trees growing up before our eyes, the rose shooting from the ground and blossoming in a minute or two. Things which we know are not possible are pictured for us—and we marvel, nor ever stop to think that all this magic and all its wonder are but a clever tricking of our sense of time, our mental valuation of an interval between ticks of the clock!

For the motion picture does for us what no other thing can do save a drug, or, in a slight degree, long, long training. It takes normal intervals of time and expands them one, two, a thousand-fold, or it takes a number of time intervals and compresses them by the same ratio. It presents all the motions of a growing flower in a month's time to our eyes in the space of five minutes—or it takes the time intervals between the several inches of progress of a flying bullet—a tiny fraction of a second—and expands them so that they occupy perhaps the half of a minute. It eliminates the time between happenings and brings two events separated actually by hours of time and makes them seem to us as following each other with no interval between them. More, it takes two happenings at different times and at different places, and makes them appear to us as happening at the same time and same place. Unconscious of this strange sixth sense of time, because it is so much a factor of our daily lives, ignorant of the fact that it is this and not our eyes alone which have been tricked, we leave the darkened theater with wonder in our hearts and admiration on our lips.

Fig. 9.—This shows a scene in the film shown in Fig. 1 before the change of costume was made.

Fig. 10.—Same setting as Fig. 9, but here the man has changed to a dress suit, while the camera was stopped.

How Is It Done?

"Now, how do you suppose *that* was done?" is our nearest guess.

Let us take some of these "time tricks" to pieces and see just how they are accomplished. Most of us have seen thrown upon the screen a picture of a patch of earth in a garden. We have watched the clods disturb themselves, seen a slender shoot put its point up through them, watched in wonder the green tip twirl and twist as if seeking the light, seen it climb up a wall, putting forth tentacle-like hooks and fasten them about the ready wires, then shoot forth leaves, then a bulb, which, opening before our astonished eyes, becomes a morning glory. If not that flower, then we have seen a rose, a lily, or a carnation, push the earth aside and grow to full maturity in a few minutes by the magic of the motion picture.

How this is done is as wonderful as it is absurdly simple. The ordinary motion picture is projected on the screen from a film which passes sixteen separate pictures through the machine every second. It was made in a camera which took sixteen separate pictures every second. We see sixteen separate pictures every second, each one slightly different from the one previous. Were our picture of a growing flower made in that way, we should sit and watch the screen for as many weeks as it took the flower actually to grow. But the flower picture, though projected at the rate of sixteen pictures a second, was made in a different way. The camera was set up in front of the place where the flower was to grow, and, by a clockwork device, was made to take the picture, not every sixteenth of a second, but every fifteen minutes! At the end of a month, supposing the camera ran night and day (at night by electric light), there would have been made 2,880 pictures on a strip of film. If these pictures are run through the projecting machine at the rate of sixteen per second, the whole film passes through the machine in three minutes. We see 2,880 pictures of a growing plant. In actuality, a period of fifteen minutes separated each of these pictorial impressions of the growth of the flower. On the screen, this fifteen minute interval is "squeezed up" 14,400 times—from fifteen minutes to the sixteenth of a second. For the three minutes we look at the presentation of the growing flower, our time sense has been speeded up so that we get in three minutes the impressions that the camera got in a month.

To get this impression in actuality, we should have to find a drug which would slow us up, so surely to the senses, that a month seemed as three minutes. Hasheesh is such a drug, but as it paralyzes all bodily activity, including sight, the only things the hasheeshed brain sees at abnormal speeds, great events taking place in minute times, are the disordered fancies and portraitures of the wandering human mind.

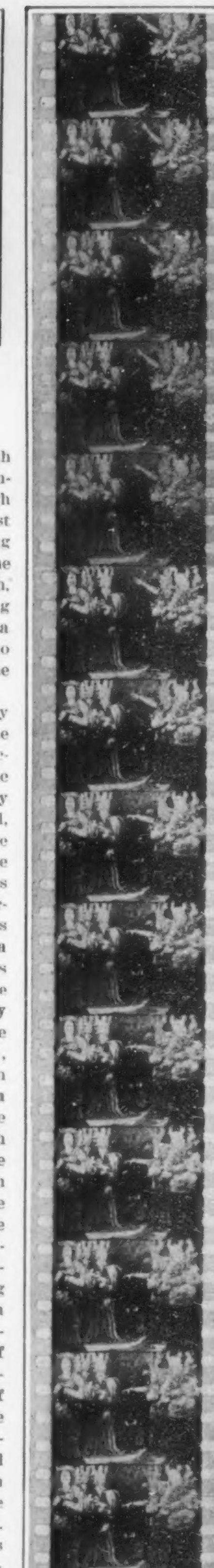


Fig. 11.—Specimen of multiple exposures and printing. Fairies and faces terrify the small man.

Your Panama Hat

From the Tropical Jungles of South America to the American Hat Store

By A. M. Jungmann

WHEN you get ready to put on your Panama hat this season view it with renewed interest. It is about the only article of apparel which is still being made in exactly the same way it was when these hats came into being centuries ago, before Columbus discovered the Americas. That is, of course, if your Panama is a real Panama. And speaking of real Panama hats, in point of fact there is no such thing. Panama hats are not and never have been made in Panama. They acquired this false name because the city of Panama was and still is the great distributing center for this particular variety of hat.

Panama hats are woven from the leaves of *Carludovica palmata*, a low growing, sturdy member of the palm family, and the finest of them come from Ecuador; others are made in Colombia and Peru. This palm, of which there are half a dozen varieties, grows wild in the semi-darkness of the tropical jungles of the Pacific coast of South America. In selecting its leaves for hat making care is exercised to take the young unopened leaves. These are pliable, white, and larger than the developed leaf. The rough outer layers of the leaf are cast away and the smooth, white inner layers which lie folded fanwise are carefully cut into, literally, thousands of fine shreds or strips varying in size from pieces as fine as the hair of a horse's tail to strips as thick as ordinary twine, according to the quality of hat to be made.

The knife used for this operation is very thin and sharp and considerable skill is necessary to cut the leaves, for the strips must not be separated from the parent stem of the leaf. The leaf when cut is known as a "cogollo." A number of leaves so prepared are tied together by the stems and submitted to a process of steeping in boiling water. After this they are bleached by methods known to the natives and are then ready to be woven into hats. The preparation of the "cogollo" is an entirely separate industry from that of the hat making. Each "cogollo" contains on an average twenty-eight straws about 50 centimeters long and weighs usually 15 grammes. The price the weaver pays for this material varies according to the fineness of the texture of the "cogollo" and the even coloring of the straws.

The hats are not woven in factories, but in the homes of the weavers. Sometimes an entire family is engaged in weaving. In the more remote districts where community life does not exist all the members of a family are provided with "cogollos" of a fineness of texture suitable to their individual skill. The children are supplied with the coarsest straws and the older and more experienced weavers with finer material. Where the population permits, the weavers gather into congenial groups. The young men of the village congregate each day and weave in little groups, lightening the time of toil with jokes and stories. Similarly the girls form pleasant weaving parties and sing while their fingers are busy with the palm strands. The older people are apt to gather together according to their skill, but there is usually one weaver whose art is so far ahead of the others that he or she is set apart and generally regarded with a generous amount of admiration or envy, as the case may be. On the whole, however, these people are of a pleasant, though somewhat phlegmatic, disposition.

The utmost perfection in weaving has been attained in the districts of Jipijapa, Montecristi, and Santa Ana, province of Manabi, Ecuador. Some of the hats produced there are almost as fine as a linen handkerchief. Such hats bring very high prices right where they are made. Wealthy planters affect them, and it is not uncommon for the equivalent of $50 to be paid to the weaver for one of these fine hats.

When one of the aristocrats desires to make a princely gift to a distinguished acquaintance, he visits the most famous weaver, say, in Jipijapa and makes known his particular desire in a hat. The weaver then devotes all his time to filling the order and when the hat is completed receives a handsome sum for it. But no matter what the pay, it surely is well earned, for the weaving of such a hat requires an amazing amount of skill and knowledge of the best sort of "cogollo" to go into its construction. Also it takes an entire season to complete one. These adepts at weaving develop a sensitiveness in feeling comparable only to our blind who have been taught to use their fingers as their eyes. The sense of touch must be delicate in the extreme to turn out the exceptional Panamas. These wonderful gift hats, which rarely ever are seen by ordinary mortals, have a texture as fine and supple as a piece of Lyons silk. The weaver who is selected to make one attains great honor in his village. Not many of the best hats are brought to this country. In the department of Antioquia, Colombia, there are weavers who turn out hats which almost any American would be glad to own, but they do not equal the Ecuador product. There is but one place in Peru where the industry flourishes, and that is in the small town and district known as Catacaos, in the province of Piura. These hats are shipped from Paita. In the countries where Panama hats are made there are but two classes of people, the rich or aristocratic class, and the poor or serving class. Many of the hats which usually find their way to the United States and are sold at moderate prices are made in Peru. They would be spurned by the upper class in the land where they are woven and could be found only on the heads of the downtrodden poor.

Copyright by Clarke & Hyde.

How Panama hats are bleached after they are received.

Copyright by Clarke & Hyde.

Panama hats are received in crates—thousands of dollars worth in a single crate.

The Panama hat, like "all Gaul," is divided into three parts. The top of the crown is called the "plantilla," the sides of the crown "copa," and the brim "falda." In beginning the hat the weaver selects eight straws which constitute the skeleton and run from the center of the "plantilla" to the edge of the "falda." While it seems that these straws could be arranged in only one way, the different localities where the hats are made each has a method of handling the skeleton characteristic of that particular school of weaving, and the placing and design of the skeleton straws are unfailing indications, to the initiated, of the place of manufacture of a Panama hat.

Starting at the center of the "plantilla," the weaver builds a series of concentric braids. Each of these fine circles is called a "carrera." The greatest manual dexterity is necessary to handle these delicate straws and interweave them with the skeleton straws, yet keep the whole symmetrical. In order to facilitate the bending and turning of the straws, the weaver keeps that part of the hat on which he is employed wet by means of a mop of straw, which he dips into a vessel of water at his hand. The entire hat is never kept wet; only a very small part of it at a time. When the crown is completed and the time comes to join the brim on to the crown, the weaver slips the crown onto a block and then attacks the "carre," as the juncture of crown and brim is called. I suppose efficiency engineers will be shocked to learn that in this day and generation the weavers of Panama hats still persist in the ancient and tuberculosis encouraging habit of holding the block in place with their chests instead of adopting a more healthful and up-to-date method. The weaver now completes the tortuous ordeal by finishing off the brim border or "remate," as he calls it. The brim is then pulled into shape by a series of firm twists and pulls and the block removed.

The loose straws which stand out, halo-like, around the border of the brim are carefully trimmed off, and the hat is ready to be washed and bleached. After all the soil has been washed out and it has been given the desired whiteness, it is once more put on a block in preparation for the process termed "masetear," which means to be beaten with a wooden hammer. This calls for great skill, for as the hammer is manipulated so is the appearance of the hat changed. When the hat looks the way the weaver wants it to be he stops beating it and very gently and painstakingly proceeds to iron it. This then completes the process and the hat is packed with its fellows to begin its commercial adventures. The hats are stacked one within the other and between them sulphur is liberally sprinkled to prevent moulding, something which must be constantly guarded against in humid, tropical countries. Occasionally when hats arrive at the distributing centers they have dark spots on them, which are not readily removed. There is a certain preparation which is sold for the removal of these blemishes, but for some reason the formula has been kept a secret.

When the hats are finished they are taken to the nearest market place on market day and there sold to the dealers by their makers. These markets are picturesque in the extreme. The gaudily dressed natives, the women wearing innumerable petticoats, the haggling crowds, the colorful display of vegetables, hats, clothes, and a thousand and one interesting objects, not forgetting the quaintly hideous charms sold by the Indians, the patient pack animals all go to make up a scene almost incredibly unique, for to-day it is just as it was generations ago. Progress has not reached the market places where Panama hats begin their journey into the great, bustling world.

The weavers of the very finest Panama hats do not need to belong to a trade union to insure their working days being shortened to accepted standards. They work on an average of from six to eight hours a day, divided into periods of from three to four hours each morning and evening, because they can handle the fine straws only when there is a certain amount of humidity in the atmosphere. During the middle of the day the air becomes too dry for successful manipulation of the delicate strands of palm leaf. The coarse hats may be woven at any and all hours.

When purchasing a Panama it is a good idea to hold

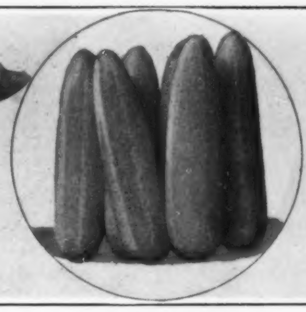
(Concluded on page 461.)

The Fly

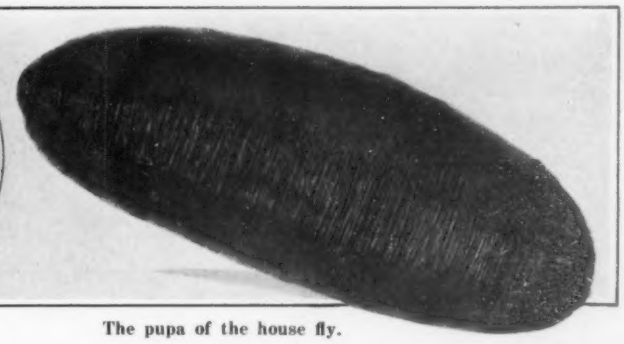
A Model of Musca Domestica 64,000 Times Life Size

By Joseph William Grigg

The larva of the house fly.



The eggs.



The pupa of the house fly.

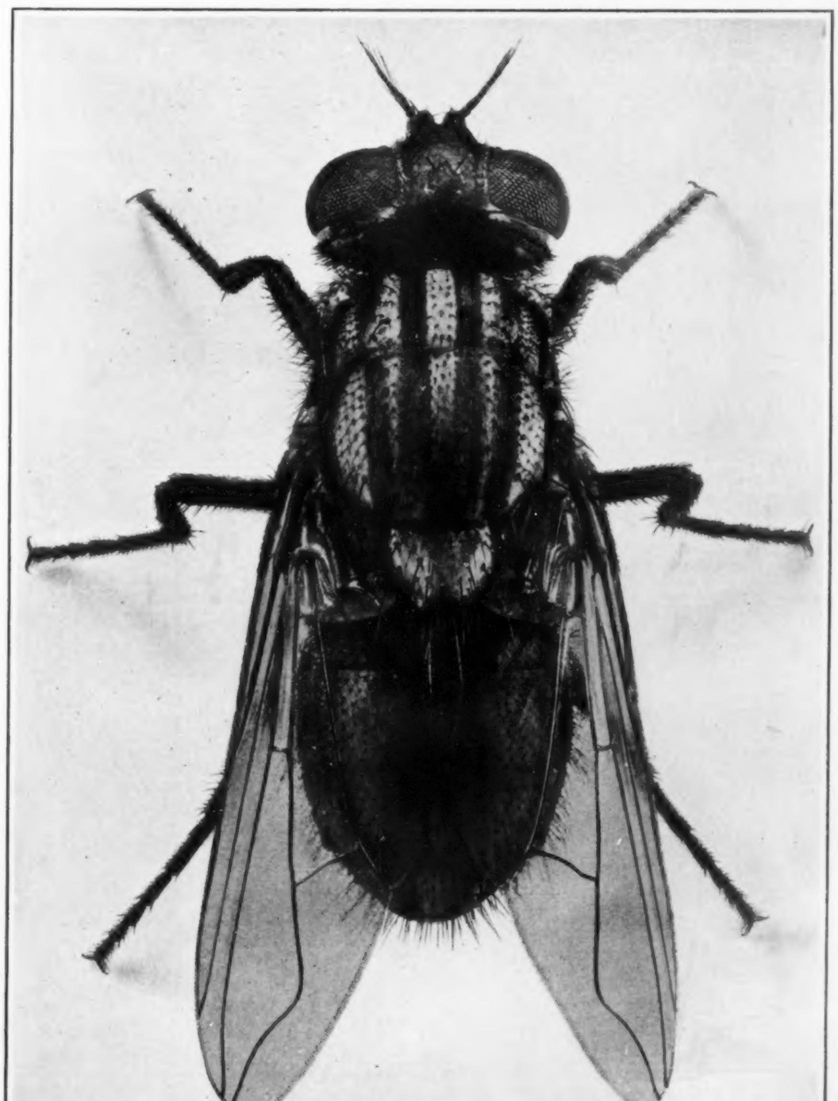
At the American Museum of Natural History you will find a house fly nearly as big as a cat, and all its disagreeableness will dawn upon you at once. The model of the house fly is 15 inches long, or 64,000 times the size of the living *Musca domestica*. It is considered the most accurate and adequate representation of the external anatomy of the house fly in existence. Not only have the more striking features been copied, but even the minor details visible on a magnification of forty diameters have been executed with complete accuracy. The eggs, larva and pupa of the fly, executed in proportion to the model, are part of the group.

The model is a graphic illustration of the life story of the fly. Man has fostered and tolerated the insect since time out of mind in all but the coldest climates of the world. The model shows the short interval from the time the eggs are laid in organic refuse to the quick development of the hungry young grub and the pushing aside of the hard case with a loose top segment and the exit of the perfect insect. It is easy to understand the fly's rapid multiplication. It has been computed that if a fly on June 1 lay one of the six installments of one hundred and twenty eggs of which it is capable, that by September it would have a progeny numbering septillions. In figures, by September 18 the number of flies resulting from that first batch of one hundred and twenty eggs would be 36,279,705,600,000,000,000, which in turn would lay 4,353,564,672,000,000,000,000 eggs. This would take into account an equal division of males and females. The possibilities for contamination can be readily conceived when it is known that the bacteria on a single fly have been known to range from 250 to 6,600,000.

No one group in the museum has created more interest than this one of the house fly, a member of the family of 40,000 species of flies in existence. There is small wonder. Of all insects captured in houses in this country in a survey in recent years 98.8 per cent were house flies.

Ignaz Matausch labored for more than a year to produce the fly model and other parts of the fly group. As a first step he studied 200 flies, stupefied with chloroform or freshly killed. This was necessary because within half an hour of death the color of the fly as well as the surface modeling changes. Even the color of the eyes was found to change a short time after death. Each specimen could, therefore, be used only for a short period.

Drawings were made of anatomical details, and are now in the museum. The head, mouth parts, body and legs were modeled separately in clay, cast in wax and smoothly finished, polished and colored. The eyes were produced with glass beads. The hardest part of the work was the insertion of the hairs with which the body of the fly is covered. It was more difficult because the hairs vary in length and bend in different directions. This was finally accomplished by constructing each hair of german silver wire. The wings were modeled in celluloid. The halteres (a rudimentary second pair of wings), the plume-like antennæ, the club-shaped palps or tasting organs were all accurately modeled and articulated into position. A magnified rectangular crumb of bread forms the mount for the fly.



Model of a common house fly at the American Museum of Natural History.

The Pacific Kelp Beds

In the bill making appropriations for the Department of Agriculture for the fiscal year ending June 30th, 1915, authority was provided to print and publish certain maps and accompanying reports relating to the kelp beds of the Pacific coast. These documents have just appeared in the form of a bulletin by Frank K. Cameron and others, entitled "Potash from Kelp," accompanied by a folio atlas showing the results of the surveys made of all the commercially available kelp beds from Cedros Island to Cape Flattery, about half the available beds in southeast Alaska, and a major part of the beds on the southern shores of the Alaska Peninsula. The maps, which are sixty-one in number and drawn on a large scale, show the location and extent of the beds, and also, by means of various tints, their character, whether thin, medium, heavy, etc.

This report, besides containing a handy *résumé* of much that has been previously published on the subject of kelp and the domestic potash supply in general, presents several new facts of great practical interest. The botany and life-history of the giant kelps are extensively discussed, chiefly from the point of view of utilization. The mode of growth of *Macrocystis* makes it possible to harvest the plant twice a year without danger of destroying the beds. Cutting of the stipes causes new stipes to grow out from the holdfasts, somewhat after the manner of the "stooling" of wheat. *Nereocystis* is apparently an annual, and more care must be taken to avoid permanent injury to the beds; i. e., harvesting should not take place earlier than the fruiting season. In the Puget Sound region this plant should not be harvested before July 15th, and in Alaska not before August.

As to the disposition after harvesting, it is stated that "taking everything into consideration—cost of production, cost of handling, and properties which will appeal to the manufacturer of mixed goods—dried powdered kelp is the product which seems to offer the best possibilities for quickly finding a substantial commercial demand."

Sections of the report are devoted to the methods of harvesting kelp, with working drawings of harvesting machinery now actually in use in California, and to a discussion of probable markets. The legal status of the kelp beds has aroused some controversy, and uncertainty on this subject has deterred large capital from undertaking their exploitation. Legislation looking to the control of the beds and leasing of the rights to harvest has been proposed in the States of Washington and California, but has not yet been effected. At present, anybody is free to harvest kelp anywhere on the coast.

The area of commercially available kelp beds on the Pacific coast is given as 389.94 square miles and the weight of fresh kelp as 59,305,500 tons. Assuming that all the potassium chloride were extracted and marketed as such, it is said that its value at present prices would approximate $90,000,000, while if the crop were reduced to dried kelp and sold at current figures for potash and nitrogen content, the value would exceed $150,000,000.

Photograph by Underwood & Underwood

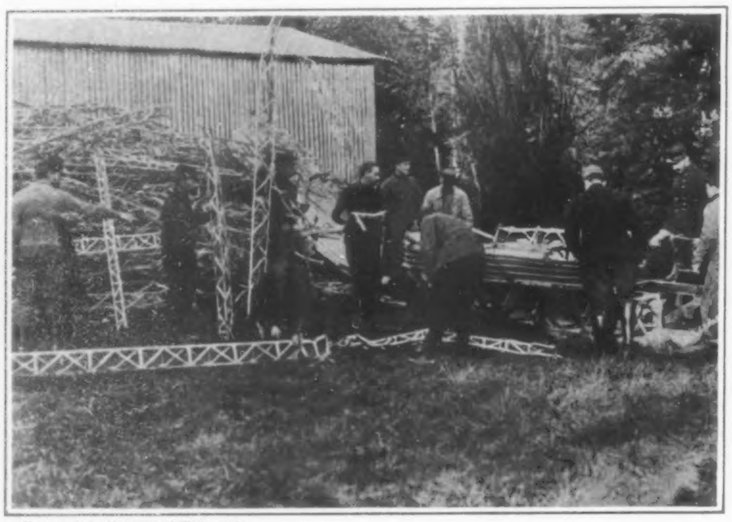
British soldiers explaining to French officers the operation of a trench pump.

Copyright International News Service

Clearing away wire entanglements by shooting a cable over them and hauling it in.

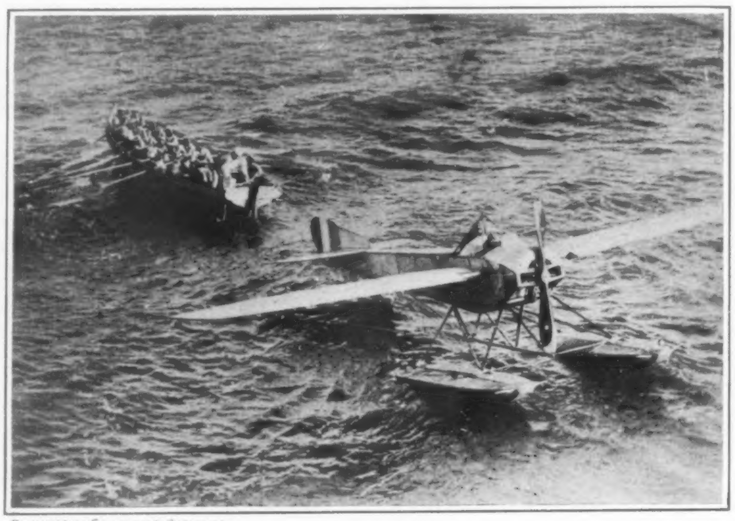
Copyright International News Service

Incendiary bombs dropped from Zeppelins in a raid over the Tyne, England.



Photograph by Underwood & Underwood

French soldiers breaking up the framework of a fallen Zeppelin.

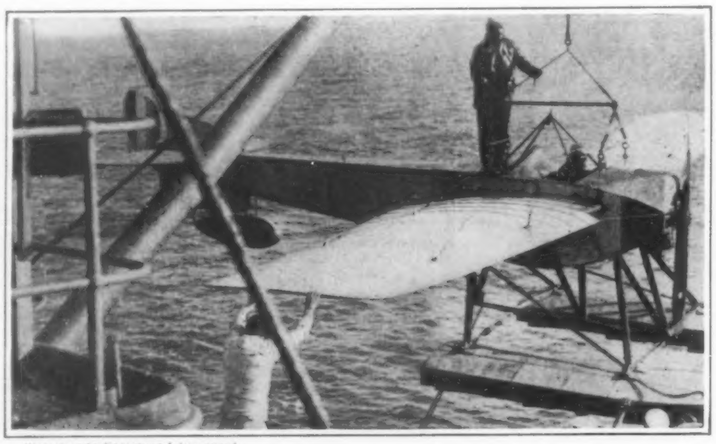


Photograph by Underwood & Underwood

Towing a seaplane back to its mother ship at the Dardanelles.

Photograph by Underwood & Underwood

Victoria cross race in which each competitor carries a dummy.



Photograph by Underwood & Underwood

Hydroaeroplane being taken aboard a cruiser after a flight over the Turkish fortifications at the Dardanelles.

Photograph by Paul Thompson

Sir James Makenzie Davidson's method of probing for bullets with a telephone.

Copyright International News Service

Austrian motor transport bringing in a load of benzine for automobile fuel.

Photograph by International News Service

Disinfecting clothes at a British field hospital.

SCENES IN WAR-TORN EUROPE

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

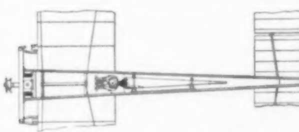
PUTTEE.—ARTHUR D. MOLONY, London, England. The invention has for its object to add comfort to all forms of putties for hard wear, especially military, without diminishing their strength; and to adapt puttees, as neater, more efficient and comfortable articles of wear, to many new uses, chiefly sporting, for which the gaiter or combination of Highland spat and

WOVEN PUTTEE FOR HARD WEAR.

stocking has been worn hitherto. To this end, the invention is characterized by a woven puttee having the warp or longitudinal strands retained jointless and continuous throughout, and having the weft or transverse strands changed in one or more suitably located longitudinal sections of the puttee.

Pertaining to Aviation.

SAFETY DEVICE FOR AVIATORS.—W. A. MACKAY, care of Mackay Colliery Co., North Sydney, Nova Scotia, Canada. The invention has particular reference to devices for making flights of aviators practically safe in the provision of a parachute adapted to be carried by the machine and to which the aviator is connected, means furthermore being provided



SAFETY DEVICE FOR AVIATORS.

whereby the parachute and aviator may be released from the machine in the case of accident and enabling him to be lowered to the earth in safety by virtue of the parachute. The use of the device for releasing an aeroplane and making the pilot independent of starting his machine without assistance, is important in face of the fact that aviators have not been partial to parachutes or life-saving devices of any description.

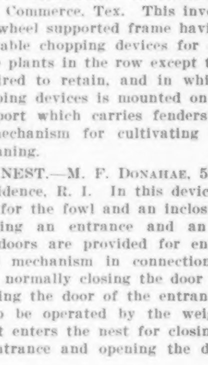
PROPELLER.—T. A. MACDONALD, 59 Fair St., Paterson, N. J. An object here is to provide a propeller, especially those designed for aeroplanes, which not only exerts a driving force in the direction of flight, but also exerts a lifting force, this lifting force being due to the peculiar shape of the blade of the propeller.

Of Interest to Farmers.

COTTON CHOPPER.—R. HAMILTON, P. O. Box 521, Commerce, Tex. This invention comprises a wheel supported frame having a series of adjustable chopping devices for cutting out all of the plants in the row except those which it is desired to retain, and in which each of the dropping devices is mounted on an adjustable support which carries fenders and cultivating mechanism for cultivating the plants after thinning.

TRAP NEST.—M. F. DONAHAE, 521 S. Main St., Providence, R. I. In this device a nest is provided for the fowl and an inclosure for the nest having an entrance and an exit, and wherein doors are provided for entrance and exit, and mechanism in connection with the doors for normally closing the door of the exit and opening the door of the entrance, and arranged to be operated by the weight of the fowl as it enters the nest for closing the door of the entrance and opening the door of the exit.

MILKING MACHINE.—A. TRUCHOT, Choteau, Mont. By means of this device the milking of a cow may be accomplished rapidly and economically and with no danger of injuring the animal. The apparatus is of light weight,



MILKING MACHINE.

and is adjustable so as to permit the movement of the animal during the milking operation. The milking operation closely simulates that of manual operation.

DRAFT APPLIANCE FOR SELF-LOADING GRAIN CARRIERS.—J. E. MOSCRIP, Derrick, Saskatchewan, Canada. This invention relates to harvesting machinery and has particular reference to propelling means or draft appliances for machinery intended for the purpose of gathering a load or bulk of hay or shocks of grain while moving across a field and then transporting such load to the place of delivery.

Of General Interest.

OIL FILTER.—E. P. BAUM, 1027 South Main St., Ottawa, Kan. This filter is designed to be reliable and efficient in use and to filter from the oil the minutest particles it may contain, and including filtering elements which can be readily taken out of the tank or body of the filter for the purpose of cleaning or renewing.

HELMET.—F. M. BOWERS, Chester, Penna. The purpose here is to provide a helmet or mask which can be easily placed from operative to inoperative position without removing the same from the head of the wearer, which helmet or mask affords a large angle of vision when in use, leaving both hands of the wearer free for work.

RECEPTACLE COVER AND SPOUT.—M. BLUME, 1405 8th Ave., Brooklyn, N. Y., N. Y. This invention relates to a combination cover and spout for a receptacle, and more particularly for a milk bottle. An object is to provide a receptacle cover and spout which can be easily and quickly secured to or removed from a receptacle and which can be easily cleaned, thus rendering the device sanitary.

LITHOGRAPHIC PROCESS.—M. R. WOOD, 218 William St., New York, N. Y. The particular result attained by the process is in the production in ink, on one object, of the effect of a design printed upon linoleum with oil pigments, in order to produce light and inexpensive samples of the various designs of linoleum, and avoid the necessity for carrying heavy and cumbersome sections of the linoleum.

EGG TESTER.—H. NIEHOFF, Flower Co., 49 Broadway, New York, N. Y. The invention has reference to an electric egg tester adapted to be used by housewives in testing the eggs they purchase, and also by egg merchants, whereby eggs can be easily and quickly tested to ascertain their degree of freshness.

PARCEL POST WEIGHING SCALE.—G. B. JUSTICE, Raleigh, N. C. The improvement is embodied, first, in an attachment for the scale-pan, consisting in the provision of a map and a guard superimposed thereon and marked with zone lines. The guard is in the nature of a transparent plate on which concentric circles are inscribed indicating different zones. By shifting the map, any particular town or unit of area may be brought to the center of the pan and the guard, and thus the scale may be conveniently made to apply to any particular town or unit of area.

FINE ORE SEPARATOR.—C. W. BELL, Rickey, Ala. The invention provides a device especially adapted for separating ore from other substances having different specific gravity, wherein the separation is based on the physical fact that such materials are moved by flowing water at different velocities, the relative velocity depending upon the relative specific gravity.

GARBAGE CAN.—J. A. JONES, Palestine, Tex. The invention relates to garbage and trash receptacles, and one of the principal objects is to provide a garbage receptacle adapted for use on sidewalks and in public parks, and including foot-operable mechanism whereby the lid of the can may be easily opened incident to the depositure of the trash or garbage therein.

Hardware and Tools.

MOLD FOR SECURING SCREEN WIRE.—C. C. BROOKS, Sheffield Station, Kansas City, Mo. One of the principal objects here is to provide a mold whereby screen wire may be detachably secured, and held in stretched position, on doors, windows, screen frames, sleeping porches and other places where wire screens are desired, the mold itself adapted to be formed into a frame.

COMBINATION TOOL.—J. H. WALKER, 120 W. High St., Lexington, Ky. This tool is adapted for use in carpentry, drafting, masonry and other work of a similar nature. The invention provides a tool which may be used as a straight edge and rule; a double right angle square; a double try-square; a double bevel square; and a double protractor.

Heating and Lighting.

ADAPTER FOR BUNSEN BURNERS.—J. I. ROBIN, 198 Broadway, New York, N. Y. According to this invention, the disadvantages of former inventions are overcome by providing a fitting which is such that it may be fitted to any standard burner attachment or mixing chamber and which is provided with any convenient number of burners or mantle supports as may be required, depending upon whether the burner is required for heating or lighting.

Machines and Mechanical Devices.

VALVE.—C. O. NILSSON, Ravenswood, W. Va. Mr. Nilsson's invention is an improvement in valves, and has for its object to provide a valve of the character specified, especially adapted for use as an exhaust valve in explosion engines, and especially of that type using the puppet type of valve.

SHIP SCALE.—J. FRAME, Searsport, Maine. This invention pertains to scales and particularly to scales for weighing ships and the cargo of ships, and has for an object to provide an improved structure wherein the ship may be weighed at any time when empty, and the cargo may be weighed as the same is taken on board.

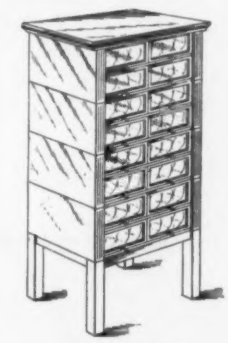
MANUFACTURE OF HOLLOW OR LIKE EARTHENWARE.—E. W. LEIGH, Ambleside, Midway, Burton-upon-Trent, England. This invention has for its object to construct a machine for the manufacture of hollow or like earthenware, such, for example, as pots or jars, for containing preserves and other foodstuffs. The pieces of clay or the like from which the pots are formed preferably consist of approximately circular solid billets or slabs prepared in any ordinary manner.

SHINGLE PRESS.—O. HORNBY, care of N. W. Lumber Co., Hoquiam, Wash. The improvement provides means for automatically pressing shingles in their bundles to tighten the shingles in the bands which hold the shingles together. The press is disposed between two gravity roller sections and these sections are connected with the press for operating the press automatically as the bundles of shingles pass from one of the roller sections to the other.

UMBRELLA COVERING MACHINE.—KATHERINE C. HOUT, 13 Chestnut St., Schenectady, N. Y., and C. T. HENTSCHEL. The invention provides means for mechanically mounting on an umbrella frame a fabric cover; provides means to operate rapidly to operate means for manually controlling the periods of operation of said machine; and provides fastening members for the cover and the outer or tip ends of the ribs of the umbrella frame, arranged in the form of a continuous strip, to facilitate the feed of the fasteners.

Musical Devices.

MUSIC CABINET.—M. A. HAWKINS, 1532 Druid Hill Ave., Baltimore, Md. This invention provides for accommodating the maximum number of music rolls in a given space; embodies the novel elements in a form constituting units of a sectional cabinet; provides trays for the music rolls, each adapted to hold a



MUSIC CABINET.

series of rolls and accommodate rolls of different diameters; provides for holding the rolls of a series in parallel orderly relation on the trays; and provides a sliding music roll holder, and at a door at its front together with connecting means for actuating the door to the movements of the sliding holder.

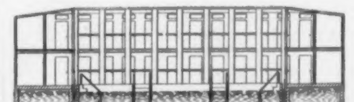
Prime Movers and Their Accessories.

ROTARY INTERNAL COMBUSTION ENGINE.—F. H. KILWINSKI, U.S.S. "San Diego," care of Postmaster, San Francisco, Cal. This invention relates more particularly to a rotary internal combustion motor or engine, which has for its object the provision of a device which simplifies the structure of engines and reduces the number of parts to a minimum, and in which greater efficiency is obtained by the omission of complicated working parts resulting in lost motion and necessitating their frequent repairs.

INTERNAL COMBUSTION ENGINE.—O. HEATON, care of W. Heaton, Rushville, Ill. The invention relates to engines particularly designed for heavy fuel oils, and the main object thereof is to provide an explosion chamber in which the force of the fuel explosion in two directions is utilized in an effective manner to actuate an operative part of such engine, instead of but one direction, as in engines as now constructed.

Pertaining to Recreation.

BATH HOUSE.—R. F. CASEY, 91 Jackson St., New York, N. Y. This invention provides a bath house more especially designed for use on rivers, bays and other waterways, and ar-



BATH HOUSE.

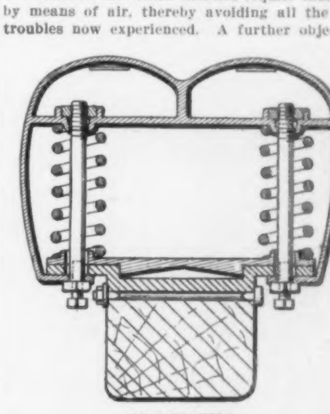
ranged to provide a basin adapted to float independently of the bath house structure and the platform adjacent the basin to protect the latter against heavy swells and waves and thus allow of keeping the basin watertight.

TOY.—J. T. MILLER, Clovis, New Mex. This invention provides a series of toys driven by spring motors, capable of being wound, and arranged to move the figures forwardly by successive starts and stops, and wherein mechanism is provided in connection with the motors for successively releasing and restraining the operation of the motors, and wherein certain of the figures are mounted to be moved in certain predetermined manners by the motors.

Pertaining to Vehicles.

ELEVATING TRUCK.—E. M. CHAPMAN and C. E. COWAN, 229 Chestnut St., Holyoke, Mass. This invention has reference to elevating trucks of that type including a link supported platform and means whereby the downward movement of the handle will elevate the platform and the upward movement will lower the platform.

TIRE.—C. L. NEELY and F. K. NEELY, Corydon, Iowa. The main object in this instance is to provide a substitute for the pneumatic tires now in use which will not require inflation by means of air, thereby avoiding all the tire troubles now experienced. A further object is



VEHICLE TIRE.

to so construct the tire that lateral resiliency of the same is possible as well as the vertical resiliency. The invention provides means for increasing or decreasing the compression of the resilient devices at will, whereby the tires may be adjusted to a contemplated load.

AUTOMOBILE TOP LIFTER.—L. JOHNSON, Address W. S. Leyens, Monroe, La. This improvement provides mechanism for use in connection with automobiles and like vehicles having extension tops, for permitting the top to be raised from one of the seats, without touching the top, and without the necessity of alighting from the vehicle.

GUIDE FOR VEHICLE SPRINGS.—M. W. MORRIS, Olympia, Wash. This inventor provides a guide for springs of light automobiles, such as those in which the springs are disposed transversely of the car. The device may be readily attached to or removed from cars without necessitating the dismantling of the parts or of weakening or in any way interfering with them.

FRONT RUNNING GEAR FOR VEHICLES.—M. L. JOHNSON, Galena, Ill. The invention is an improvement in the forward axle-support of four-wheeled vehicles, particularly such as are self-propelled, the objects being to provide elimination so far as practicable of side thrust, and twist or torsion in passing over uneven surfaces, and to locate the point of pivotal connection between the front axle and the chassis as low as practicable.

VEHICLE END GATE.—J. A. RAMSEY, Address L. Crocker, Allen Block, Beatrice, Neb. The primary object of the inventor is the provision of an end gate in which a vertically swinging end gate is provided with oppositely extending bails that limit the lateral extension of the two retaining wings or members, and permit of the folding of the members against the end gate when the end gate is closed.

BELT GUIDING DEVICE.—R. H. WEATHERSBY and W. B. CLARK, Mammoth, Ariz. The invention relates to an attachment for vehicles, particularly driven vehicles, and is in the nature of an improved belt guiding device forming part of a belt traction device for use in sections of the country where loose, sandy soil is predominant and the vehicles retarded as a consequence thereof.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

AMERICA FALLEN! The Sequel to the European War. By J. Bernard Walker. New York: Dodd, Mead & Co., 1915. 16mo.; 203 pp.; 5 plates. Price, 75 cents.

In this book the naval and military unpreparedness of the United States is demonstrated in the form of a dramatic narrative, which shows how helpless this country would be against a sudden and carefully-planned attack by a first-class naval and military European power. The naval and military disasters depicted in this story are based upon the warnings which, year after year, have been given in the annual reports of our leading naval and military authorities, and in the reports of the Secretary of War and the Secretary of the Navy. The European war ends favorably to the Allies in the spring of 1916, when Holland declares war and a powerful allied army invades Germany, crossing the German frontier to the east of the Rhine and capturing the great sources of German artillery and ammunition supply in Westphalia. The treaty of peace is signed at Geneva, and Germany, to prevent the disruption of her fleet, agrees to pay an indemnity of 15 billion dollars. In view of the fact that it was largely the munitions of war supplied by the United States that enabled the Allies to win, Germany feels that she is entitled to levy that 15 billion dollars upon this country. She sends her fleet and an expeditionary army of 200,000 veterans of the war to collect the money, and the last ten chapters of "America Fallen" show how swiftly and with what deadly certainty the thing is done. On April 1st, at dawn, one hour after the declaration of war reaches Washington, half a dozen flotillas of the famous German submarines show their periscopes above the water in half a dozen ports, dockyards and naval stations of the United States, and, within half an hour, not a submarine or destroyer of our navy is afloat from Boston to the Panama canal. The same night an advance force of 20,000 men is landed and the forts protecting Boston and New York are taken in reverse. The German dreadnoughts enter the harbors, demand 5 billions ransom from New York and 3 billions from Boston—and get it. Washington is captured and the seat of Government is moved to Pittsburgh. The United States long-distance radio stations are captured, and the German Intelligence Service having become possessed of the navy secret code, our fleet of 10 dreadnoughts at Vera Cruz is lured to Cuba, met there by a fleet of 22 German dreadnoughts, and the battle of the Caribbean, the greatest sea fight in history, is fought. The great German transports bring over and land at Boston, New York and Philadelphia a force of 200,000 picked veterans of the European war, who within a few days of the declaration of war take possession of every arsenal, gun, rifle and powder factory east of the Alleghanies. The American forces (70,000 effectives) are withdrawn to Pittsburgh, and near this city, on the historic ground at Braddock, they are overwhelmed by a German army of 150,000 men, whose artillery, four times the strength of that hastily gathered by the defense, decimates our gallant forces. Pittsburgh is evacuated and the seat of Government is removed to Cincinnati. Here, acting on the advice of its naval and military chiefs that it would take from three to six years to build the factories and construct the guns and equipment necessary to equip the millions of volunteers and get them into such shape as to ensure the driving of the millions of the German army of occupation back to the sea, the Government decides to pay the indemnity demanded and "write it off on the National Ledger as the cost of being taught the great national duty of military preparedness." This work may not please but it will certainly fascinate the American reader. If he reads the first chapter, probably he will not put the book down until he has read the last.

THE "SHIPPING WORLD" YEAR BOOK. A Desk Manual in Trade, Commerce, and Navigation. Edited by Evan Rowland Jones. London: The *Shipping World* Offices, 1915. 8vo.; 2,004 pp.; with new map of the world. Price, in the United Kingdom, 10s. net; in other countries, 11s.

The familiar green cover with its Ethiopic Neptune and his ebon nymphs reminds us of former annual meetings with our old friend, "The *Shipping World* Year Book." It presents the usual complete port and harbor directory of the British Isles, and of commercial ports of the world. The "tariffs of all nations" includes the new Colombian tariff; this section is somewhat affected by the war, to the extent that the tariffs of Germany, Austria-Hungary and Turkey could not be revised to date. Important new legislation affecting shipping is given. Among other new or revised features are the list of radio stations of the British Isles, an abstract of the Suez Canal Regulations, and the shipbuilding and shipping bounties and subsidies of foreign countries. There is a new map of the steamship and railway routes of the world, showing the ports, coaling stations and coalfields of all countries.

L'ACETILENE. E De Sue Pratiche Applicazioni. Illuminazione: Riscaldamento: Saldatura Autogena: E Taglio Rapido Dei Metalli: Legislazione, Ecc. L. Castellani e U. Romanelli. Milano: Ulrico Hoepli, 1915. 16mo.; 355 pp.; 115 illustrations. Price, L. 4.

This is a treatise quite characteristic of the Hoepli library, condensed, yet thoroughly practical. It deals with acetylene in its various applications, and it is not especially difficult reading for students of the Italian language. Illumination, heating, autogenous welding, and cutting, are all treated of, and the legal restrictions governing the production and use of the gas are given. Small as the treatise is, it is well and adequately illustrated.

Panama Hats

(Concluded from page 456.)

it up to the light and look through it to see whether or not there are any knots or patched places in it. Sometimes in making them the strands are broken and additional ones have to be woven in. This spoils the texture, although it is not noticeable in a cursory examination of a new hat. When the hat has been worn such ends are inclined to stick up and ruin the appearance of the Panama.

A good Panama hat will withstand the roughest kind of usage. It is an ideal protection for the head from both sun and rain. It may be subjected to all sorts of indignities, but the one so often inflicted on it here in the United States, and that is bleaching it with acids when all it requires is a careful washing in warm water assisted by a generous lather of Castile soap. Do not fear to wash it as often as you wish. Have the water warm, not hot, and use all the soap necessary. If possible, dry it on a block, but if no block is available, stuff it with paper or cloth and dry it in the sun. The only bleaching a Panama hat can stand is sun-bleaching. The fine straws crack and break within a few days after they have received an oxalic acid bath.

Edison Submarine Boat Storage Battery

(Concluded from page 450.)

lead placed directly on the keel of the craft, to afford increased stability and safety. Furthermore, the Edison battery is more durable, and it is not damaged by prolonged or oft-repeated over-charging, and it may be charged and recharged to full capacity without affecting its useful life, its life not depending upon the number of cycles of charge and discharge, but on a period of time, four years figuring in the present guarantee of the manufacturers. The Edison battery can remain charged, semi-charged, or totally discharged for indefinite periods without injury, and consequently it is not necessary to operate the engine and generators, as in the case of the older types of cells, which require constant attention for forming or correcting the plates. In other words, and what is important on the military side, it is always ready for instant use. The electrolyte contains no acid, and whatever chlorine gas is generated, through the decomposition of saltwater by electric current, immediately becomes iron chloride through the affinity of that metal for chlorine. This is due to the large amount of iron present in the steel jars, as well as in the plates of the cell. The Edison battery does not shed its active material, nor is it affected by the continued and oft-repeated short-circuiting. There is no necessity to take the cells apart or to remove any sediment, which in the case of a lead-sulphuric acid battery for a submarine may amount to from 7,000 to 12,0000 pounds, and materially affect its trim. There is no danger of the accumulation of gas, as in the top of each Edison cell there is a water-trap which forms an effective seal, and should there be a sufficient accumulation of hydrogen and oxygen in any single cell, sufficient to produce an explosion, the steel jar possesses sufficient strength to resist it, while the water-trap prevents any fire within the cell from reaching the exterior. No specific gravity readings are necessary oftener than one about every six months, to determine when it is necessary to renew the solution. The electrolyte used in the Edison cell not only preserves, instead of corroding the steel, but it also absorbs the carbonic acid gas exhaled by the crew, for there is sufficient potash to absorb all the CO_2 thus given off for 100 days. In this process no harm is done to the battery and the carbonic acid gas may be removed from the electrolyte when opportunity arises after a protracted submerged run.

Comparing the Edison battery with a lead battery to be used under similar conditions in a submarine, a typical installation of the former has a capacity of 910 kilowatt hours when discharged in three hours. In the same number of cubic feet, and with a saving of about 1,600 pounds in weight, an Edison storage battery will

be installed which will have a capacity of 1,212 kilowatt-hours when discharged at the three hour rate, after a normal charge, and 1,347 kilowatt-hours when discharged at the three hour rate after an overcharge. These Edison cells have been tested for rough usage under extraordinary conditions of vibration, oscillation, bumping, overcharge, short circuit, etc., and it is expected that the good features already shown, will develop also in actual service; thus increasing the efficiency and radius of action of the submarine.

Power of Mind in Baseball

By Arthur Macdonald

THERE are three general mental states in which a ball player may be; overconfidence, lack of confidence, or nervousness. Overconfidence can cause a player to make an error through want of sufficient effort. Thus a good fielder will muff an easy fly to the surprise of everyone, including himself. The ball may have been twirling more than usual, but he was in a relaxed condition, and his grasp, as a result, was not as quick and strong as usual. It is doubtful if any major league player has any lack of confidence in catching a fly if he can get to it with reasonable effort.

Lack of confidence comes to the batter when puzzled by the pitcher, or when he is thinking of the pitcher's great reputation. Nervousness is the worst condition of all, for even the best players when in such a state may play the worst.

Stanage, a great catcher, says, "Catching demands one third ability and two thirds mental work." Edward Collins states that grounders do not come as hard to second base as to first or third, "but when it comes to the other part of the game, the thinking part, second base becomes a difficult position. Baseball games are won in many instances because players think quickly." Collins was on first, the batter had three balls and no strikes, and nobody was out, yet he stole second base, and was severely criticised. But as no one believed he would try to steal under such conditions, he felt sure he would succeed by doing the unexpected. Coombs says next to control in pitching comes head work.

Frank Chance holds that "confidence is half the battle in baseball." It is certainly one of the greatest mental forces in the game. Thus a weak team that has been winning is harder to beat than a strong team which is losing. A fresh young pitcher is more difficult to hit than an experienced one who is uncertain of himself. One team is helpless before a pitcher that a weaker team pounds all over the field. A batter is unable to make a base hit on one pitcher, yet can hit the same kind of ball from another pitcher. There are not a few players retired or returned to minor leagues who have lost confidence in themselves.

A base on balls is better than a hit, because it may affect the pitcher more and tend to lessen the confidence of the team.

Joe Tinker, an ordinary batter, was convinced he could hit Mathewson, the great pitcher, and Mathewson seemed to have the same belief, for Tinker won five games from New York by his individual batting in one season.

When a pitcher hits a batter, it may discourage his side and destroy confidence in him. When a player has a quarrel with another or with the umpire, I have noticed that he is liable to be upset in his playing as well. Many important physical movements are unconscious, but when a player becomes irritated his nervous system is easily thrown out of gear, and this unconscious action is affected.

When the first batter up is retired half the inning is over. The mental state produced by this bad beginning is probably the cause. Nearly every baseball game is decided by one play at the psychological moment, which is called the "break." Why a weak team will beat a strong team and be beaten by another weak team with regularity, are mental problems.

An unexpected hit may flurry the pitcher and make him pitch badly to the next batter, and the game may be lost.

The failures of some fielders to hit can worry them much and make their fielding bad also.

The crowd may affect the umpires, who are popular in one town and disliked in another. In certain cities the weakest umpires succeed best, because they yield to the clamoring of the crowd in close decisions.

I have noticed that when a fielder fumbles a ball he is more liable to make a bad throw, especially if the fumble is inexcusable. The cause of this may be that, experiencing disappointment or shame, he feels desperate, and throws accordingly.

It is unfortunate to have the idea that a pitcher is hard to hit, no matter how true it may be; for if the batter did not have this idea, the pitcher would be easier to hit. An illustration is the case of Walter Johnson, who for an unusual number of games defied the batters of many different teams, until he was suddenly hit hard by the Cleveland team. Johnson claimed he was in the best of form and pitched as good as he ever did, and his claim was doubtless true. But it was the psychological condition of the Cleveland batters that made the difference. As soon as batters become confident that they can hit a pitcher, even if they fan occasionally, they are very liable to hit any pitcher as long as they persist in such a mental attitude. The great reputation of a pitcher in the minds of many batters may be a strong factor in preventing him from being hit. When one fears he cannot hit the pitcher (he should banish such feelings), if he fouls the ball, this tends to give him confidence, that he can at least hit it somewhere; whereas if he strikes out, his fear may be increased. Rallying may be explained in a similar way. A good hit raises hope in the next batter and there is a rush; this mental state may also be produced on the home grounds by systematic and rhythmic encouragement (clapping) of the crowd. The lucky seventh inning sometimes shows the result of this. The rally at batting occurs, notwithstanding the fact that the pitcher who could not be hit before the rally is often pitching just as well as ever. It may be the mental condition of the batter that has changed, rather than the pitching of the pitcher. On the other hand, the batting rally itself may cause the pitcher to lose confidence and pitch badly.—Abstracted from *American Physical Education Review.*

A Study of Coral Reefs

DURING most of the year 1914 Prof. W. M. Davis of Harvard University was occupied in visiting and studying islands in the Pacific Ocean with the object of testing the various hypotheses that have been proposed to account for the formation of coral reefs. The problem is an old one, but has been the subject of especially active discussion in recent years. In an account of his investigations just published Prof. Davis, after reviewing various other attempted explanations, states that Darwin's simple theory of subsidence is the only one that appears to account satisfactorily for the formations he has visited. This theory assumes a slowly subsiding ocean bottom, as a result of which the islands gradually sink, diminish in size, and eventually disappear, while the fringing coral reefs grow upward and are converted into barrier reefs and atolls.

Reinforced Concrete Work in Egypt

A REMARKABLE piece of reinforced concrete work is the jetty at the port of Alexandria, Egypt. The entire construction has a total length of 330 feet, and is made up of a series of caissons in reinforced concrete which are floated into place in the sea. Such caissons are 5 in number and measure 66 feet long by 26 feet wide and 20 to 22 feet high, and are built on the Hennebique system. Caissons are let down a slipway into the water, and one or more steam tugs serve to tow them into place, where they are let down on the prepared bed of the sea. Concerning recent work in Egypt we may also mention an embankment wall on the Nile at Ghesireh which was very successfully carried out.